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THE CORK OAK.

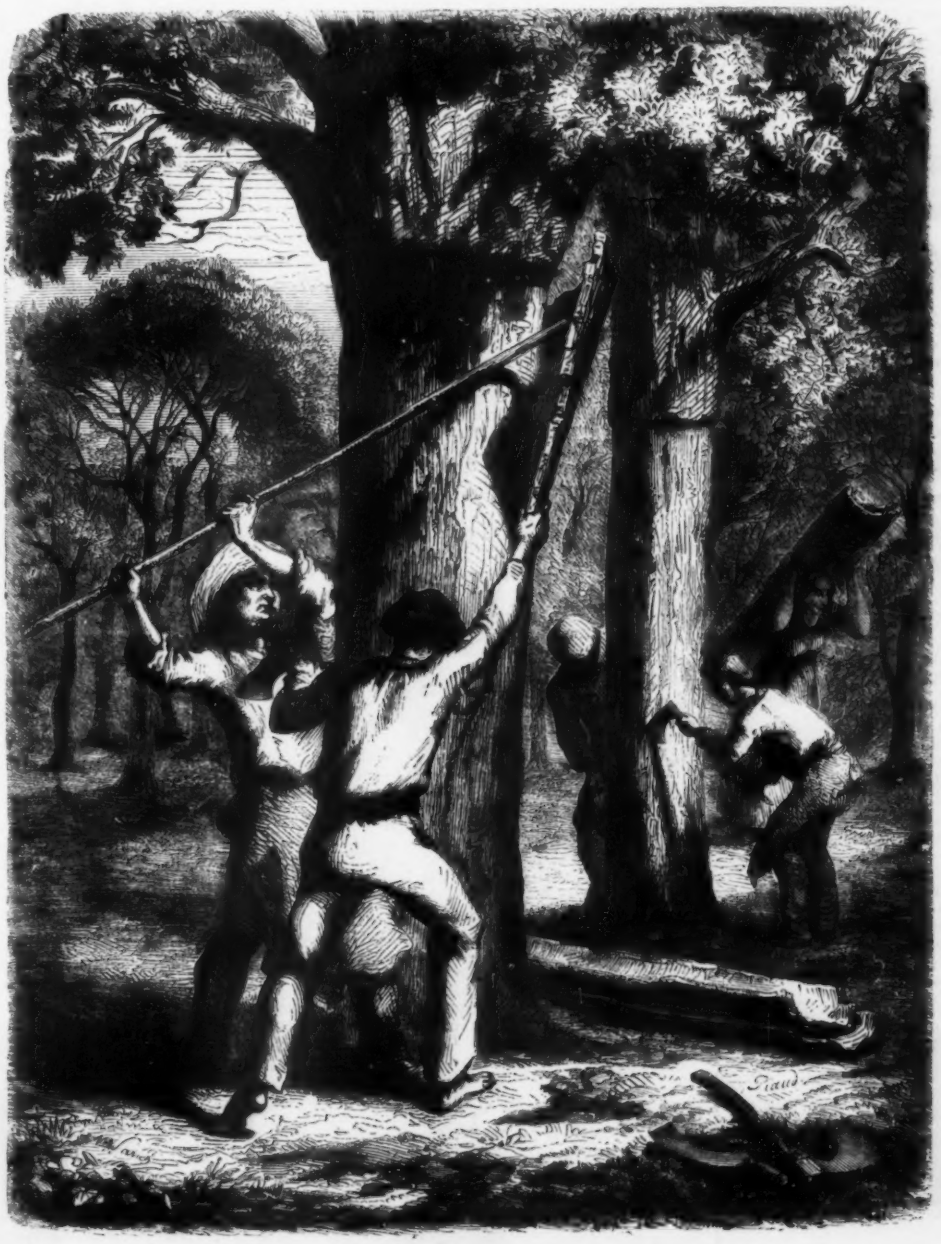
THE tree from which is obtained the cork of commerce is a species of evergreen oak (*Quercus suber*), growing in several of the departments of France, in Spain, Portugal, Sicily, Italy, and Algeria. It is principally cultivated, however, in Spain and Portugal. This species of oak loses its foliage only in the month of May, and when the new growth of leaves is sufficiently strong to replace the old ones of the preceding year. It flowers in May, and its fruit is fit for gathering only in the month of November of the next season; that is, eighteen months after flowering. Its acorns are less astringent than those of other species of oaks, and are used for fattening swine, sheep, and poultry. They are also employed to a considerable extent in the manufacture of certain kinds of fecula.

The cork oak flourishes best in arid, sandy soils, and under favorable conditions reaches a height of 40 to 50 feet, with a circumference of 10 to 13 feet. The trunk, from its base up to where the first branches begin, is 9 to 13 feet long; and it is this portion of the tree from which is peeled the bark that constitutes the cork of commerce. This substance, "cork," consists of the outer layer of bark, which, by annual additions from within, gradually becomes a thick, spongy mass, the rapidity of growth determining the quality of the bark. A quick growth is represented by a fine grain and light weight; a slow growth producing a contrary effect. The bark, if allowed to remain on the tree, becomes so fissured and cracked as to be unfit for use. There are two varieties of the cork bark known in commerce, the white and the black; the former of these is the product of trees growing in France, and the latter of those cultivated in Spain. The white is superior to the other on account of its greater beauty, its smoothness, and its greater freedom from cracks and inequalities. It is of a yellowish-gray color on both surfaces, and cuts (on account of its much finer grain) more smoothly than the black. The operation of stripping the bark takes place when the trees have attained the age of 15 to 20 years. In the month of August, when the sap is in movement, the workmen begin by making a transverse incision in the bark, just beneath the branches, and another at the base of the tree; then two longitudinal incisions are made, and the bark beaten on every side with the back of an ax, in order to loosen it from the subjacent liber; then by means of their ax handles, or of levers prepared for the purpose, they pry off the loosened bark, which falls to the ground in cylindrical pieces. During this process the greatest care is used not to injure the newly formed layer of suber or cork lying beneath. After collection the rough exterior of the bark is either rasped off or slightly charred, then piled in stacks and allowed to dry, during which process it loses one-fifth of its weight. In the charring process, the pores become closed up, and the cork is rendered denser, or receives what is technically known as "nerve." In this state, after being flattened, it is cut into lengths of about 4 feet and put up in bales for export.

The stripping takes place about every ten years, the product improving with each successive removal. The operation seems to be beneficial to the tree, for if the bark be allowed to remain on it naturally, the cork oak rarely lives longer than 50 or 60 years; if, on the contrary, it be removed periodically, the tree continues to flourish from 100 to 150 years. The first product is always of a very rough and woody nature, and useful only in rustic work or as a tanning material. The second stripping is also of a coarse nature, and useful only for floats for nets, water conduits, and such purposes.

The economic uses to which cork is applied are much too numerous to pass in review; it will be sufficient to speak of one only, that of the manufacture of stoppers. For the purpose of stopping bottles cork was not generally used till nearly the end of the seventeenth century. Many substitutes for it have been proposed, but except in the case of aërated liquids none of these have been generally employed. In the manufacture of bottle corks, the bark is cut up into slips, which by means of gauge are made narrow or wide, according to the size of the corks or bungs wanted. The slips are then cut into squares or "quarters," which are trimmed into the required shape by means of a very long, thin knife, kept very sharp. In this operation the knife is kept immovable while the cork is drawn over its edge by the workman. The corks are then thrown into baskets and sorted out according to size by women and children. Cork-cutting in Catalonia and the South of France furnishes a livelihood for a considerable portion of the population of those districts. Several attempts have been made to cut corks by machinery, but they have not succeeded in superseding hand labor, which is comparatively cheap abroad. The machine which is principally used for this purpose, was exhibited in operation at the Paris Exhibition; it was worked by a woman, and near her was seated a man patiently carving out his corks (with the usual knife), quite as neatly and nearly as rapidly as the machine. The cork-cutting machine is an instrument similar to a carpenter's plane working in a groove, the knife being horizontal. The slip of cork is placed between two chucks, and by pushing the plane along the groove the cork is caused to rotate in front of the knife as it passes along.

No economic use is made of the wood of the cork oak except that of fuel, although it might be useful as a timber, since it is very heavy and as hard as boxwood.



WORKMEN GATHERING CORK.

THE codling moth lays about 200 eggs in the course of the season.

THE PHYLLOXERA.

ACCORDING to Prof. C. V. Riley, we have had in this country from time immemorial an insect which has attacked our native grape vines, forming galls on the leaves (Fig. 1, next page) or gall-like excrescences on the roots (Fig. 2). This insect is polymorphic, as many others of the family to which it belongs are known to be. It also exists in two types, the one, which may be termed *radicola*, living on the roots, while the other, which may be called *gallæcola*, dwells in galls on the leaves. The latter is found more especially on the Clinton and its allies, while the former is found on all varieties, but flourishes best on vines belonging to European species (*V. vinifera*). The leaf-gall-inhabiting type was described, although imperfectly, in 1856, but the root-inhabiting form, being less conspicuous, was unknown in America until about the year 1870. Owing to the microscopic size of the insect, nothing could be easier than to transport it unobserved from one country to another on grape roots, seedlings, etc., and it is not surprising, therefore, that this is what actually happened. The place of its first invasion in France has been traced with tolerable certainty to Tarascon, where all sorts of American plants have long been cultivated. It undoubtedly existed in France some years before its ravages attracted attention, and the first notice of its destructive work was made in the vineyard of M. De Penarvan, at Ville-Neuve-les-Avignon, in 1863. The scourge soon increased and spread, and in 1868 and 1869 acquired such dimensions as to thoroughly alarm the great grape-growing districts of France. No effectual means have as yet been found to stay the onward progress of the devastating insect, and the aspect of the phylloxera question is to-day still more alarming than ever, not only in France, but in Spain and other wine-making countries of Europe. Prof. C. V. Riley, in his "Fourth Annual Report" as Entomologist to the State of Missouri, in 1872, gave a full account of the insect and its habits as far as they were then known, and subsequently has succeeded in working out its complete life history. In 1873 appeared an article in *La Nature*, which also gave an account of the pest, and which was pretty complete for that date. In the current number of the same journal we find a further history of the pest, from the pen of M. Maurice Girard, and from which we obtain the following information. In order to comprehend the recent discoveries that have been made, it will be necessary to give a short *résumé* of what was before known on the subject of the phylloxera of the vine — *Phylloxera vastatrix*. This insect belongs to a tribe — *Phylloxeridæ* — intermediate between that of the *Aphidæ* or plant lice and of the *Coccidæ* or bark lice. The phylloxeridæ multiply through many generations agamically, or without the intervention of males, like the plant lice, but they are never viviparous; and, in all the phases of their existence, they lay eggs like the coccidæ. The vine phylloxera is, as we have before stated, a polymorphic species, in which we find three very clearly marked phases. First, there are *sedentary* females, living principally upon the roots of the vine, and exhausting them by their suction. They lay, in minute heaps, unimpregnated ellipsoidal eggs, which are at first of a pretty sulphur yellow and then of a grayish tint, and in which may be seen with the microscope two red dots—the eyes of the embryo. From these eggs there issue larvæ, which at first wander about, and at length become females, three-quarters of a millimeter long by half a millimeter wide, of a brownish-yellow color, and having somewhat the appearance of little lice. We give a representation of this form, highly magnified, in Figs. 3 and 4. Although very minute, these sedentary females may be distinguished with the naked eye. The roots of the vine are sometimes so thickly covered with these females and their larvæ and eggs, that they appear as if dusted over with a yellow powder, and this easily rubs

off and stains the fingers when the infected roots are handled. The wingless, sedentary female phylloxeræ are provided with eyes composed of three facets, and they are not only able to find their way beneath the soil from one root to another, but also to come to the surface and travel above ground from one plant to another. Their progress is very slow, and did they exist alone in this one form, it would be an easy matter to keep them within certain limits by sur-

Fig. 1.—LEAF COVERED WITH GALLS. (After Riley.)

rounding the infected vine with an insurmountable barrier of wood or coal tar. Since the fecundity of the successive generations of these agamic wingless types gradually becomes weaker, and the number of eggs gradually diminishes, through unisexual propagation, they would naturally tend towards complete extermination.

Unhappily for the grape grower, nature has foreseen the possibility of such an event, and has supplied the remedy.

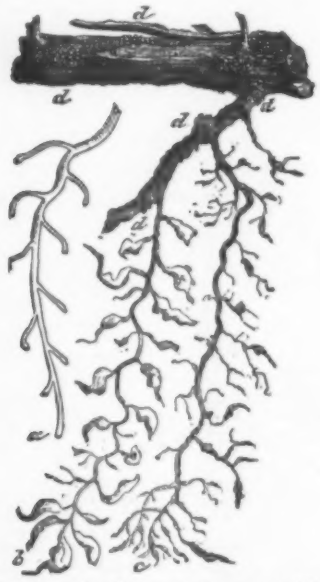


Fig. 2.—*a* shows a healthy root; *b*, one on which the lice are working, representing the knots caused by their punctures; *c*, a root that has been deserted by them, and where the rootlets have begun to decay; *d*, *d*, *d*, show how the lice are found on the larger roots. (After Riley.)

Just in the measure that the warmth increases, and that the wingless subjects multiply in consequence, certain individuals seem to have the instinct that nourishment is going to fail the subterranean colonies. These individuals become more elongated, and after a month appear with two pairs of black, superposed appendages at the sides of their body, these being the sheaths of the four wings of a new phase. The insect in this, the pupa stage (Fig. 5) slowly travels up

Fig. 3.—VENTRAL VIEW OF AN AGAMIC WINGLESS PHYLLOXERA, AND EGGS OF SAME. (Both highly magnified.)

toward the base of the vine, and sometimes even comes out on the surface of the soil. Another moult then takes place, and there appear females (Fig. 9) unaccompanied (as in the preceding form) by males. These females are *migratory*, and are provided with four large, clear, iridescent wings, the anterior pair much longer than the body of the insect. Notwithstanding the small size of the winged female, she is able through the strong nerve structure of her wings to make long flights of from 6 to 7 miles, which is about the ordinary rate of advance of the phylloxeric invasion. But by means of strong winds the insect may be carried to even a greater distance; and this fact, along with accidental transportation on carriages, wagons, grapes designed for the table, etc., will explain the sudden appearance of the phylloxera sometimes at localities remote from the original point of infection. These females suck the juices of the aerial parts of the

Fig. 4.—PROFILE VIEW OF AN AGAMIC WINGLESS PHYLLOXERA.

vine, such as the stems, buds, and leaves, by means of a beak similar to that of the wingless females inhabiting the roots, but much shorter. They carry in the abdomen from 3 to 5, and sometimes as many as 8, eggs. These eggs are of two sizes—the smaller, which produces males, about three-fourths the size of the larger, which produce females (Fig. 7). One of the most important points in the life-history of the phylloxera for a long time remained unsettled, and that is as to where these migratory females deposited their eggs. This interesting matter was determined simultaneously and independently, in 1875, by Prof. C. V. Riley in the United States, and by M. Balbiani in France; the fact being ascertained that the eggs are laid on the young leaves of the vine. The winged mother dies soon after ovipositing, and the eggs

Fig. 5.—FEMALE PUPA. (Ventral View.)

Fig. 6.—SEXED PHYLLOXERA: VENTRAL VIEW OF A FEMALE READY TO LAY HER EGG.

are hatched on about the tenth day after deposition. The sexed individuals which emerge from these eggs are at once distinguished from all the other forms which this interesting species assumes, by the obsolete mouth-parts, the sexual organs, and the more highly developed nervous system; otherwise, in size, in smoothness, and in obsoleteness of the basal joint of the tarsus, they most closely resemble the newly

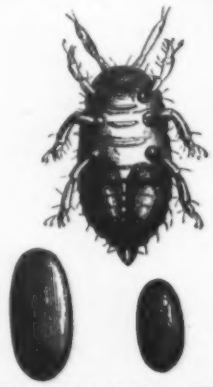


Fig. 7.—A SEXED PHYLLOXERA: VENTRAL VIEW OF A MALE; AND MAGNIFIED MALE AND FEMALE EGGS OF A WINGED AGAMIC FEMALE.

hatched larvæ. They are entirely wingless (both males and females) and live but a few days, occupied solely with the work of reproduction, their pairing taking place on the bark of the vine. They do not eat, have no digestive tube, and, instead of the long beak of the agamic winged and wingless forms, have only a short and flat tubercle unfitted for sucking (Figs. 7 and 8).

It will now be understood why the winged females settle down together in swarms on the vines. As the sexed individuals which are hatched from their eggs are unprovided with wings, they need to be near each other in considerable numbers so that a union may take place; for, if they were isolated here and there, they would necessarily perish without reproduction. The sexed female measures about 0·4 mm., and is about one-third as broad; the male differs in no respect from the female except in the prominent sexual organ. The female carries but a single egg, which develops rapidly

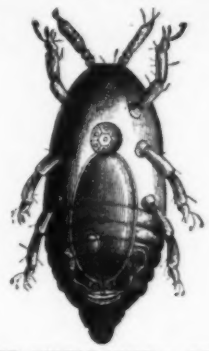


Fig. 8.—A SEXED PHYLLOXERA: VENTRAL VIEW OF FEMALE.

after she is born, and on the second day already occupies nearly the whole of the body (Fig. 6). It is delivered on the third or fourth day, and generally whether impregnated or not. This *winter egg*, which is always laid above ground, is deposited on the stock between the chinks in the bark, and never on the leaves; this important fact was discovered by M. Balbiani. This egg is smooth like the other eggs of the species, but is more elongated or ellipsoidal. It measures 0·32 mm. long, and is about one-third of that dimension broad. When first laid it is bright yellow, but soon becomes of an olive green, speckled with blackish points, and its surface is

Fig. 9.—AN AGAMIC WINGED FEMALE PHYLLOXERA.

finely reticulated with hexagonal meshes. Owing to its minute size it is difficult to see it with the naked eye as it lies on the bark, adhering by means of a small hook. The mother dies all shrunken and shriveled soon after ovipositing, and becomes of a reddish-brown color (Fig. 10).

To M. Balbiani belongs the credit of having ascertained that this winter egg hatches out in spring, during the month of April. In 1876 this observer had the good fortune to witness the process, and to ascertain that the insects proceeding from the egg were, as might have been expected,

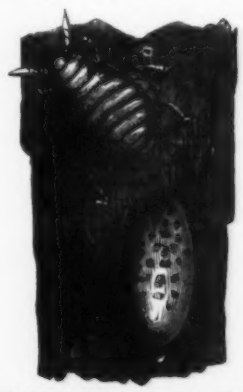


Fig. 10.—A SEXED PHYLLOXERA: FEMALE AFTER LAYING HER EGG, AND A VIEW OF THE WINTER EGG.

the agamic wingless female forms whose mission is to begin again the cycle of the "phylloxeric" life.

What then becomes of these agamic mothers filled with eggs, which are thus hatched from the winter egg? Some of them immediately seek the roots and surround themselves with the eggs which are to start a fresh devastating colony, while an occasional individual, where the conditions are favorable, settles on a tender leaf, and founds the gall-inhabiting type. Up to within a few years, these leaf-galls were known only on American vines. They are much less fre-

quent on the leaves of the French vines, and were not observed on them until the year 1875. Experiments then made demonstrated the truth of a fact that had long before been discovered and pointed out by Prof. C. V. Riley, viz., that the insects of the leaf-galls and those of the roots are identical. As a general thing, owing to the extreme heat of summer, the leaf-galls on the French vines dry up, and their insects are either killed or forced to migrate to the roots of the plant.

From the foregoing facts, it will be seen that an invasion of a vineyard by the phylloxera is always preceded by a laying of winter eggs by sexed individuals, which are the progeny of winged migratory females. The problem to be solved, then, in the destruction of the phylloxera, is how to get at the winter egg, before it hatches in spring. If the root insects are allowed to hatch out it may be said that it will prove an absolute impossibility to kill them all, even by means of the best insecticides known, on account of the thousand obstacles opposed by the soil. The destruction of the winter eggs may be effected at this season by several processes: by a slight decortication of the stock with stiff brushes or gloves of mail, taking care always to gather and burn the scrapings; or by scalding the stock with hot water or steam; or, finally, by covering the vines with a coating of some insecticide. One of the best of these has been found to consist of:

Water	2 parts.
Heavy oil of coal tar	2 parts.
Carbonate of soda	1 part.

The whole to be boiled together for an hour over a slow fire. To apply it, first dilute with 9 volumes of water, shake well, and spread it on the stock by means of a brush. The application should be made in February, March, or the beginning of April, according to the climate, and a little before the time of hatching of the winter egg. As for the leaves which bear galls, they should be picked off by hand and burned.

In conclusion, it may be said that the complete natural history of the Grape Phylloxera can now be considered as established. "A full biological view of the species," says Prof. Riley, "exhibits to us no less than five different kinds of eggs: (1) the regularly ovoid egg, 0·25 mm. long, of the normal, agamic, and apterous female, as it is found upon the roots; (2) the similar but somewhat smaller egg of the gall-inhabiting mother; (3) the female egg from the winged mother, rather more ellipsoidal, and 0·50 mm. long when mature; (4) the male egg, from the same, one-fourth less in length and rather stouter; (5) the impregnated egg from the sexed wingless female, 0·32 mm. long, and still more ellipsoidal. We have also the singular spectacle of an egg from the winged mother increasing from 0·34 mm. (its size when laid) to 0·4 mm. (its size just before hatching); giving birth to a perfect insect 0·4 mm. long, and this in turn, without any nourishment, laying an egg 0·32 mm. long. A being is thus born, and, without any food whatsoever, lays an egg very nearly as large as that from which she came."

SPONGE-BORINGS IN MARBLE.

MOST naturalists are aware of the power possessed by certain sponges forming the genus *Cliona* of boring into the shells of mollusca and other hard bodies, but we are hardly prepared to hear of their making their way into so refractory a substance as statuary marble. Prof. Verrill, however, states (*Silliman's Journal*, November, 1878) that the Peabody Museum of Yale College has lately received some fragments of white Italian marble from a cargo wrecked off Long Island in 1871, and taken up this year, in which "the exposed portions of the slabs are thoroughly penetrated to the depth of one or two inches by the crooked and irregular borings or galleries of the sponge *Cliona sulphurea*, V.," and reduced "to a complete honeycomb readily crumbling in the fingers. Beyond the borings the marble is perfectly sound and unaltered." Prof. Verrill remarks that the possession of such boring powers by this apparently insignificant sponge may have a practical bearing in the case of submarine constructions of limestone or similar materials.

THE APPLE TREE BORER REMEDY.

IN the first place, be careful to remove all sprouts, suckers and grass from the roots of the tree. Secondly, keep the bark near the surface smooth and clean by frequent scouring or rubbing with the naked hand. This should be done at least once a week during the months of May and June. This will brush off the eggs. Another remedy, and perhaps a more effectual one, is to take one pint of sulphur, add to it one gallon of soft soap, and tobacco water sufficient to make it of the consistency of common paint. Apply it with a brush in May or June on the body of the tree at the surface, and two or three inches below. I think if the above remedies are used faithfully, no borers would be found to trouble the apple trees.

FERTILIZATION OF THE QUEEN BEE.

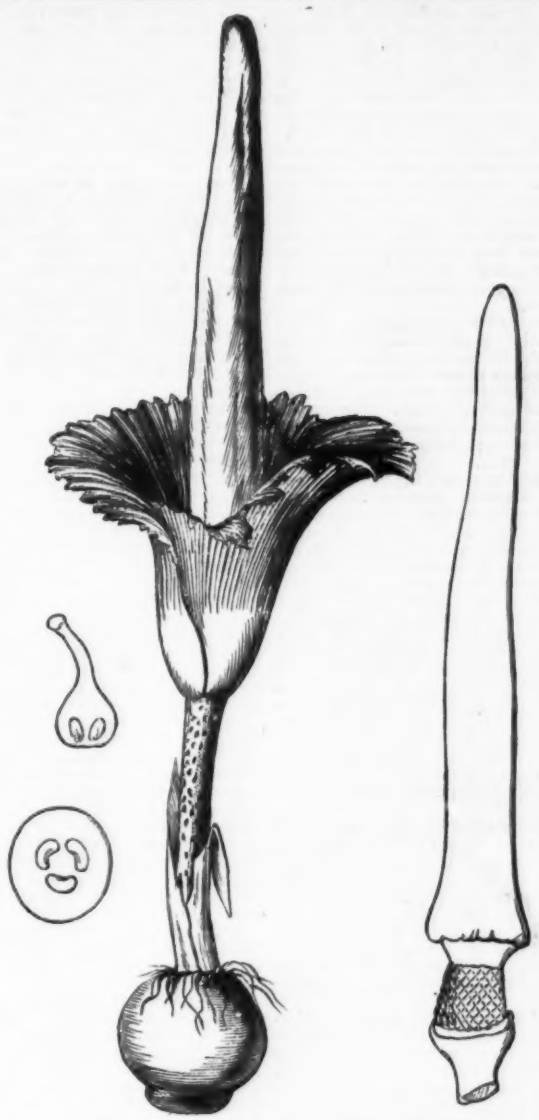
By T. B. MINER.

PERHAPS it may interest some of the readers of the magazine to learn how the impregnation of the queen bee was first discovered. I copy from the "American Bee-Keepers' Manual," a work written by me nearly thirty years ago, being an extract from Huber's book on bees, written in 1792. This celebrated naturalist was blind at the time he investigated the natural history of the honey bee, and did all his work by the aid of an assistant by the name of Beurnens:

"At 11 o'clock in the forenoon, we placed ourselves (Beurnens was the one to watch for the queen, directed by Huber, yet he always wrote as if he could see) opposite to a hive containing an unimpregnated queen five days old. The sun had shone from his rising, the air was very warm, and the males began to leave the hives. We then enlarged the entrance (Huber had contracted the entrances of several hives to prevent the egress of queens) of that selected for observation; and paid great attention to the bees entering and departing. The males appeared and immediately took to flight. Soon after the young queen came to the entrance; at first she did not, but during a little time traversed the board, brushing her body with her hind legs; neither workers nor males bestowed any notice on her. At last she took flight. When several feet from the hive she returned, and approached it, as if to examine the place of her departure, perhaps judging this precaution necessary to recognize it; she then flew away, describing horizontal circles twelve or fifteen feet above the earth. We contracted the entrance of the hive that she might not return unobserved, and placing ourselves in the center of the circles described in her flight, the more easily to follow her, and witness all her motions. But she did not remain long in a situation favorable for our observation, and she rose rapidly out of sight. We resumed our place before the hive; and in seven minutes the young queen returned to the entrance of a habitation which she had left for the first time. Having found no external evidence of fecundation, we allowed her to enter. In a quarter of an hour she reappeared, and after brushing herself as before, took flight, then returned to examine the hive, and then rose so high that we soon lost sight of her. This second absence was made longer than the first—it occupied twenty-seven minutes. We now found her in a state very different from that in which she was after the former excursion; the organs distended by a substance thick and hard, very much resembling drone sperm, and completely similar to it in color and consistence."

I am inclined to believe that much that Huber has written as his discoveries in the natural history of the honey bee is not reliable in consequence of having to trust everything to his assistant; but the manner in which the queen bee is impregnated, on the wing by the drones, as he states, is undoubtedly correct.

Where is the evidence in the experience of American apiarists that "if a queen's fecundation be deferred twenty-one days, she thereafter lays nothing but drone eggs?" Suppose a hive contains no drone comb, it is not reasonable in my view to say that she will lay drone eggs in worker cells; and if laid in such cells, how are they to mature in cells two-thirds the size of drone cells? In forty years' experience I never had a case of a queen laying only drone eggs; and I do not believe any such theory possible. Huber claims that when a queen deposits drone eggs in worker cells, the workers "carry away such eggs only to devour them." Who has ever seen workers carrying out drone eggs under any circumstances? I never did, nor do I believe that anybody ever has; and in regard to eating them, I consider that as pure fiction. But Huber made some discoveries that were a great advance in the history of the bee in his day. He discovered the ability of the workers to make queens from worker eggs, or larvæ under four days old. This is the most wonderful feature of the history of the insect. How is it done will probably never be known. It may be the peculiar food ("royal jelly"), or it may not. A late writer claims that the workers deposit around such eggs or larvæ a fluid substance, which if a little be attached to the head of a pin, and placed around any worker egg it becomes a perfect queen, if room be afforded to grow in, simply by inoculation! This theory is worthy of our consideration and experiments to test its truth.—*Bee-Keepers' Magazine.*



CONOPHALLUS TITANUM—THE LARGEST FLOWER IN THE WORLD.
The Spadix (6 feet long) is represented at the right.

THE LARGEST FLOWER IN THE WORLD.

HITHERTO the largest flower in the world has been supposed to be the *Rafflesia Arnoldii*, of Sumatra and the Sunda Islands, the flower of which measures nearly nine feet in circumference. This plant, however, now no longer enjoys this distinction, a still larger one having recently been detected in Western Sumatra by Dr. Beccari, and one which casts all similar productions in the shade. The newly discovered plant is a gigantic aroid, which has been named by its discoverer *Conophallus Titanum*. From Dr. Beccari's description, we learn that the specimen he examined possessed a spadix nearly 6 feet long, the height of a rather tall man, and this not including the height of the scape, and measuring the length of the flower from the point whence the spathe expands to the top of the sterile appendix. The scape was not much taller nor thicker than the stalk of some leaves (which he found 20 inches long and 3 inches thick), of a green color, marked with small whitish orbicular spots. The largest diameter of the spathe was nearly 3 feet, and 28 inches deep; it was campanulate in shape, with deeply toothed edges, which were also closely crumpled. The deeper portion of the interior was of a very pale greenish color, and the limb of a bright black purple hue. The outside of the spathe was pale green; smooth in the lower portion, but thickly corrugated and crisp above. The spadix deprived of the spathe measured more than 5 feet; for 8 inches of its length only it was covered with pistils underneath and with stamens above them, the sterile organs being entirely wanting. The appendix in consequence is reduced to a total length of 4·25 feet, having at the base a diameter of 8 inches, gradually tapering towards the extremely obtuse apex. The surface of the appendix was nearly smooth, but widely corrugated in the sense of its length. Its color was of a dirty yellow at the base, becoming nearly livid towards the top. The leaves of the plant are much like those of *Amorphallus Campanulatus*, but much larger in size, covering an area of 45 feet in circumference! The tuber of the plant measures 5 feet in circumference! The accompanying illustration of this vegetable monster is from an original sketch by Dr. Beccari, and will convey a good idea of the general appearance of the plant. It is reduced about one-thirteenth! Dr. Beccari has succeeded in sending on a few tubers, which have arrived healthy and sound at Florence. Such is the history, as far as we know it, of this most extraordinary plant. On looking at fossil animals and plants we often say, "Verily, there were giants in those days," but Sumatra may, indeed, boast of giants that are still in existence.

THE PITH PLANT.

AMONG the plants which contribute to the health and comfort of Europeans in the tropics, a not inconspicuous place must be given to that which produces the Shola or Sola pith of India, *Æschynomene aspera*, from which the sun *topees*, the helmets, and pith hats are made, as also exquisite ivory-like models of temples, etc.

Though the plant is common in Ceylon, it is, as far as we know, only thoroughly appreciated and rendered serviceable to man in Assam, Bengal, the Coromandel, and other parts of India.

The genus *Æschynomene* belongs to the pea family (*Leguminosæ*), and between thirty and forty species are known. Though the species are found in the greatest numbers in Brazil, they are met with in most tropical countries. In India and Ceylon there are two species recorded, both common in wet places. *Æschynomene aspera*, or rough-surfaced

Æschynomene, derives its specific appellation from the prickly tubercles which when mature appear on the middle of each joint. The plant may be recognized, growing by the side of pools and paddy fields, by its orange pea-like flower, jointed pods, and sensitive tamarind-like leaves. It is essentially a swamp species, and is distributed over the Coromandel, Silhet, Assam, Bengal, and most parts of India. In Ceylon it is "common in the hotter parts of the island," and flourishes in marshy places, by the sides of rivers and streams, and in the shallow reaches of tanks. The stems are perennial, very stout in proportion to the size of the plant, erect and smooth, except at the joints, simple or little branched. They are full of a white and spongy pith, which is tough, elastic, and extremely light. From its lightness and low power of conducting heat the pith is remarkably fitted for making all kinds of helmets and sun *topees*, possessing qualities which afford the best protection to the head from the rays of a tropical sun.

If we take the strict etymology of the word pith as from the Danish *pit*, pith or kernel, then the substance contained in the stem of the *Æschynomene* is not a true pith, viz., "the inner vesicular substance which clothes the inner surface of a hollow trunk," but a light spongy wood which makes up the whole of the substance of the stem. The central part of the stem, where the pith of exogenous plants is generally found, is, in the case of the *Æschynomene*, a hollow cylinder with thin transverse walls.

When examined under the microscope, the pith (wood) of the *Æschynomene* is a more beautiful object than even that of *Aralia papyrifera*, the rice paper plant of China, which is so favorite an object with microscopists at home. In a longitudinal section the cells are seen arranged as hollow hexagonal cylinders or barrels side by side; their walls are very thin and light, and combine the greatest strength with the least possible weight. In a cross section the ends of the cylinders or barrels assume mostly a hexagonal form, the partitions between the superimposed cells, viz., and those which divide the upper from the lower are made up of an irregular network—the sieve cells of the German botanists—of which the open parts answer to where the membrane is wanting, and the threads to the parts where the tissue remains to strengthen the walls of the cells. When young these cells were filled with fluid which circulated freely from cell to cell and nourished the young parts during their rapid growth. When full grown the cells became dried up and empty, and appear as so many air chambers with firm light walls.

The shola pith plants flower during the rainy season, and in India the stems are gathered during the dry months of March and April. They are brought into Calcutta and other towns from marshy places near and sold in the bazaars for various purposes where elasticity and lightness are required. The natives use the pith as floats for their fishing nets, and convert it into fancy articles, such as models of temples, toys, artificial flowers, etc. It is also largely used to make bottle cases, swimming jackets, and fireworks; to construct some of these the wood is cut into thin slices and pasted together.

Its chief and most valued use at present is the manufacture of pith hats and helmets, and for this alone an immense quantity is consumed every year. As the qualities of the pith become more widely known, other uses in the arts and sciences will surely follow. In England the wood of the shola is being now strongly recommended as a packing around shafts in delicate machinery, to close joints, and to prevent friction. It is said to be preferable to all other substances for this purpose, being softer and less gritty than cork, and, consequently, not wearing the machinery so fast.

COWS AND THEIR BUTTER.

AT the recent meeting of the Vermont Dairymen's Association, held at Montpelier, a paper on "Dairy Stock" was read by R. S. Skinner of Tunbridge, who stated in substance, says the *American Cultivator*, that the great object of this association has been the improving of the products of the dairy; and, as these depended upon the improvements of stock and of the soil, with its products, we find that this field for progress is almost without limit; its boundary can only be circumscribed by the limits of the mind.

For the dairy the selection of stock is of the greatest importance. All coarse, large-boned animals should be rejected, since they are not the best stock for a dairy farmer. They should be fine in limb, with a well-shaped, rather small head, with a well formed udder; chest should be wide and ribs round. Cows that have had the best of feed while young will, as a general rule, make the best milkers. The udder and veins around it are the best indicators of a good milker. If the veins around the udder are large, the indications are that these parts are active. The time that a cow goes dry will depend upon the size of the fœtus, since a cow cannot make both calf and milk at the same time. Sudden fear, excitement of every kind and pain greatly affect both quantity and quality of milk.

It is very important that the farmer look carefully to every circumstance which tends to the best welfare of his animals, and as carefully guard against everything which may militate against their highest usefulness. They have been placed under his care, by a wise Providence, for the best interests of mankind in general. First, their skins should be kept clean. They should have plenty of fresh air; he would rather his stable were a little cold rather than warm and badly ventilated; yet he would use every means to keep his animals warm. His cows are Jersey grades, with one full blood. He sets his milk in pans 25½ by 30 inches and 4½ inches deep; sets his milk 2½ inches deep; endeavors to keep his milk at a temperature of about 60°; in summer churns at 60°, and in winter at 65°.

When the butter is just granulated, and before it is gathered, he sprinkles on a little salt and adds cold water, when he turns the churn a few times round. He does not work his butter a great deal; uses a board and lever, pressing the butter down flat, and with a sifter, supplied with a wire bottom, applies the salt at the rate of three-fourths of an ounce to the pound. He does not re-work his butter, but puts it up immediately in lumps. For the past three years his butter has netted him from thirty to thirty-eight cents per pound. The product of five cows and two heifers part of the year was between 2,200 and 2,300 pounds, or more than double the average product of Vermont cows.

The platform was next occupied by Dr. Cressy, on the subject of "The Dairy Cow." He said the hope of this association is to increase the products of the State, and also to improve them, and by such improvement increase the demand for butter and cheese. Some persons have an idea that there is a great falling off in the production of butter in Vermont; but the fact is, there is more butter made here now than was the case ten years ago.

We have, at this time, three prominent breeds of cattle—the Durham for beef, the Ayrshire for milk and the Jersey for butter. All animals have in their exterior that which indicates what we may expect from them. If we are in want of a horse to trot, we do not purchase a Clydesdale; or, if we want a horse to run we do not select a trotter. So the Durham, by the soundness and even development of every part of its form, indicates an animal which will make an abundance of beef. The angularity of the Jersey indicates an entire lack of fat and a deficiency of muscle. We are well aware that the tendency of the Jersey is to butter. Whenever we attempt to develop any particular feature in the animal function to an extreme, it will be done at the expense of the other qualities; hence the animal will be irregular in its form, while lack of symmetry is lack of beauty. The Durham, when loaded with fat, is almost as irregular in form as the Jersey, and much more unwieldy. The Jersey has a large udder and milk vein, which do not correspond with the rest of the body.

There is but a slight difference between the composition of blood and milk. The Jersey cow's milk contains more butter and less water than the Ayrshire cow, while the urine of the Jersey cow contains more water than that of the Ayrshire cow. In order to make butter we must feed that which will make most tissue. It is a mistake to suppose that we can dispense with the muscle producing element in the feed when we are making butter, since the production of butter depends as much upon the albuminoids as upon the carbo-hydrates or the fatty matter. The better we make the soil the better will be our feed and the more butter we can make. We cannot make a large amount of butter and of muscle at the same time.

A great butter cow will always be a poor cow; not only will she be deficient in fat, but in muscle also. The system is continually changing, but the udder changes the fastest. The butter comes from the waste of the udder, which besides butter produces urea, and this contains the nitrogen of the udder. In the cow that makes the most butter we find the most urea; this is rich in nitrogen and changes into carbonate of ammonia. The tissue of the whole body changes and the result is butter and urea.

Sugar is the result of the destruction of starch. This change is continually at work in the vegetable kingdom, and though these changes are continuous yet the carbo-hydrates change much slower than the nitrogenous compounds. Nitrogen makes few compounds that are at all permanent as we understand the word. Hence albuminoids easily change to carbo-hydrates or to fatty matter and urea. A farmer had a large quantity of sorghum growing for fodder. He commenced feeding when it was young before the sugar was formed, and it yielded a large amount of butter, but he let it stand till the starch was changed into sugar, and the production from feeding at that stage was small. That feed which will sustain and develop all the organs of the body will make the most butter. If you feed that which contains but little if any phosphate of lime you will produce little butter.

Bone meal will aid in the production of butter. Cows chew bones because there is a lack of bone material in their feed. Bran and shorts contain large quantities of phosphate of lime, consequently cattle fed with either or both will not lack bone material. Bones that are burned lose no phosphoric acid, but they lose ammonia, the gelatine of the bone being destroyed, while the earthy matter remains. Immerse the largest bone of the ox in hydrochloric acid, and in a few days the bone will lose its lime, though the gelatine will be left and the bone will be so soft that it can be bent in any direction. There is a disease called bone waste. The softening is caused by an acid generated in the system, while the lime thus set free is found in the urine. Sometimes children do not assimilate bone material when the body grows, but the bones remain stationary. This is a disease called rickets. Thus we see the necessity for bone material, which farmers never should waste. Bones are sold in Vermont at $10 per ton, which when ground are re-sold at from $30 to $40 per ton in Connecticut. Farmers should join in the ownership of a bone mill, and not allow a single bone to go out of the State, but bring as many into the State as possible.

You cannot have a good butter cow unless you have a good farm, and to keep this latter in a high state of fertilization, manures must be applied which contain all the elements of fertilization. If you stop milking the Jersey cow she will make beef of the finest texture, while the fat will be yellow like butter, but she will not make as many pounds of beef from the meal fed as some other breeds. The globules of blood in human beings, in the cow, the horse and the sheep are nearly of a size. When the infusion of blood is necessary it may be taken from any of these animals, but taken from any others the consequences would be serious, since the globules of blood being larger would not pass through the finest arteries. Muscle is homogeneous, the cells of which are always growing. The larger the cell becomes the harder it grows, and when the hardest point is reached it is dead and falls off and decomposes, butter and urea resulting therefrom.

CURE OF FACIAL NEURALGIA.

INTERESTING DENTAL OPERATION—PHILADELPHIA DENTAL COLLEGE, DEPARTMENT OF ORAL SURGERY.

CLINICAL SERVICE OF PROF. J. E. GARRETSON, M.D.

Resection of inferior dental nerve.—Our first case to-day is that of a patient in my private practice who comes to me from New York, accompanied by his physician, with the intention of having the nerve removed from the lower jaw. This disease, as you will conclude, is that of neuralgia. The cause of this neuralgia, as inferred both by the patient's medical adviser and myself, exists in an irritant associated with the maxillary canal; such a diagnosis being led to by the history of the trouble.

As already in our course we have employed the time of four lectures in studying this subject of neuralgia, I propose to-day confining my remarks entirely to the case before us.

The gentleman who, for our benefit, is kind enough to allow of the proposed operation being done in your presence, has been a sufferer from facial neuralgia for the past six years. During this period his almost continuous paroxysms of pain have denied him all social intercourse; indeed, as he tells me, he has not found himself able to go to church in all this time over half a dozen times. To move his jaws is to excite pain; consequently, as you will conclude, he has grown into a state of taciturnity.

The trouble began by the exposure of a tooth-pulp. Following pulpitis was periodontitis. Succeeding this last is the tic-douloureux. The pain, while found over the tract of the trigeminus at large, presents itself as having its seat in the lower jaw. In this seat it is that the paroxysms always begin. Along the line of this bone is to be recognized a continuous tenderness. In this situation is to be seen always evidence of undue vascular excitement.

The conclusion arrived at in the case we consider is, that in the maxillary canal exists some source of irritation to the nerve upon which the neuralgia depends. What the exact lesion may turn out to be we will not commit ourselves by attempting to define; the nerve itself may be diseased; an inflammatory exudate may press upon and worry it; there may possibly turn out to be a foreign growth developing within the canal.

With the assistance of the gentleman's physician and my able clinical helpmates, Doctors Cryer and Dorr, I propose to cut down upon the inferior maxillary nerve and remove it. The particular operation to be practiced is one designed by myself, and I venture to assert that it is one which requires only to be known to supersede every other yet employed. The merits of this operation are simplicity as to performance, full and free exposure of the nerve, freedom from hemorrhage, avoidance of observable scar, and absence of trouble in the after-treatment.

Having the patient seated in the dental chair, with the body well thrown back—a position that answers the purposes of the operator very well—we proceed to place him under the influence of the anæsthetic. . . . He is now thoroughly under the influence of the ether we have given to him. . . . The first step in the operation is to uncover the external face of the body of the maxilla. To do this I draw up the tissues from below the jaw until they rest upon the bone. Next I sink the point of the knife through the soft structure until it strikes the bone. Observe, if you please, that the heel of the blade is in front of the facial artery, and consequently that, as I make this long cut forward, I run no risk of cutting that vessel. The cut completed I now introduce this retractor, and by its aid pull the artery backward. Next two other retractors are used, separating and holding apart the lips of the wound. . . . A succeeding step is the removal of a strip of periosteum corresponding with the breadth of the maxillary canal. To accomplish this I use the common rhaspatory, which, as you see, is here associated with the handle of the scalpel. . . . Now I am ready for a succeeding step, which is the removal of the roof of the canal. To accomplish this I use a circular saw revolved by the engine. First, I find a starting place by freely exposing the anterior mental foramen. Now I may go backward as far as I please.

(The saw-cuts, as well as the general exposure, are understood through the accompanying diagram.)

In this particular instance I am sorry to have to say that the engine lacks power to allow of a rapid performance of the operation; the cord is not tight enough and the bone is uncommonly dense. An oversight is not, however, always a bad thing; the present one suggests the showing of a different manner of getting away this roof. The manner is this. (The removal of the roof of bone was completed by using a delicate chisel and mallet.)

Observe now how complete the exposure. Upon this bent probe I lift out of the canal the vessels it contains. This is the nerve; you who are near will remark that it is quite shriveled. The dental artery—this is it—is really nothing but a cord. Observe what I here lift up from the posterior part of the canal. There evidently has been an inflammatory effusion, and this shreddy tangle is the result. I assert, gentlemen, that never before, on the living subject, has any man here present seen a more complete exposure of these vessels. I do not hesitate to say that I am proud of the conceiving of this manner of operating. It will not be long before this will be the only manner of uncovering this nerve practiced. You who are familiar with the common modes employed will be sure to agree with me.

You have heard all of you of nerve-stretching for the cure of neuralgia. How satisfactorily can we practice it here! See, I cut the nerve at the anterior foramen. Now I hold the end between my fingers; I may pull and stretch at my pleasure. Certainly stretching is an indication in the present case. It is the intention to make the second division of the nerve at the posterior foramen. This foramen, you will remember, is situated on the inner face of the ramus, just below the sigmoid notch. Here is a knife I show you that is to be likened to a hoe excavator. I introduce this instrument into the canal, and feeling for the foramen I cut off the nerve just below it within the canal. Here I hold up before you the ablated nerve. You will see by its length that this last cut has been made at the point proposed.

If in doing this operation it is thought well to cut the artery, there is not the slightest trouble in throwing ligatures about the cut ends. In this case I have not cut the vessel. It is because I have not cut it that the operation is unattended by hemorrhage. I now proceed to smooth off and round the edges of bone, and particularly do I assure

myself that no particles remain lodged about the wound. Without this care a union by first intention is not to be hoped for.

To finish the operation, I bring together below the jaw the edges of the wound, and fix the parts by a few stitches of the interrupted suture. . . . Looking now upon the patient's face, you cannot say (as sight of a wound is concerned) that he has ever been touched by a knife. I think, gentlemen, you will not dispute my right to be gratified with such manner of resecting the inferior maxillary nerve.

* * * * * * * * *

The patient remained in the city from Saturday until Wednesday evening, when, the wound being healed, he left for his home. No single twinge of pain was felt by him while in town. Since his departure he has not been heard from.—*Dental Cosmos.*

DENTITION.*

No description of the diseases of the mouth in infancy and childhood is complete which does not include an account of that great process of development termed dentition, or teething, and its effects upon the welfare of the infant both in health and disease.

This process is, undoubtedly, of the utmost importance to the individual, as it involves great changes in mode of life and alimentation, and necessarily implicates, directly and indirectly, the whole economy.

If you will examine the jaws of a still-born infant, at full term, and if you will remove the anterior walls of the alveoli, you will find the teeth, in different stages of development, occupying their follicles and concealed beneath the covering gums. At this time, however, none of the roots have reached the bottom of their sockets. After birth, as the teeth grow, their roots extend down to the bottom of the alveoli. Further growth in a downward direction now becomes impossible, and from this time the teeth develop upward, press upon the gums, and finally perforate them.

It is evident, then, from this description, that some months must elapse after birth before these developmental changes can be accomplished, and that the appearance of the teeth will indicate that the digestive organs are prepared to receive, and that the system of the infant requires, new kinds of food, no longer to be obtained by the simple process of sucking, but food demanding mastication and insalivation. It is for this reason doubtless that the salivary glands at birth furnish little or no secretion, and that this condition of inactivity exists until the teeth begin to develop upward. As a consequence of this you will find that the mouth of a very young infant is dry, and that, when the child has fever, its mouth becomes painfully dry. Two or three months before the first teeth make their appearance, the salivary glands begin to secrete profusely, as a result, doubtless, of sympathy with the growing teeth still concealed beneath the gums.

The infant's mouth now constantly overflows with saliva; so great indeed is this salivary flow that the secretion is constantly actually pouring from the mouth, and the child's dress is kept wet with it; hence usually at this age infants are supplied with a special article of toilet called familiarly the "slabbering apron," which contrivance is made of thick, absorbing material. It is fastened around the neck, and as soon as it becomes wet with saliva it is removed and a dry one substituted in its place. By means of this arrangement the child's dress is kept dry, and the danger of taking cold from the constant dampness is avoided.

During the first few months after birth, and before the upward development of the teeth begins, the infant's gums are of a pale pink color, and no appearance of the underlying teeth is evident. As soon, however, as the teeth begin to grow upward, the gum changes its shape and color. It becomes broader, smooth and tense, and finally the outline of the tooth beneath the gum can be seen, and at the same time the tooth itself can be felt through the thinned overlying structures. The change in the color of the gum is also striking. From a pale pink the gum covering the perforating tooth becomes first red, then deep red, and in some cases purple.

PERFECTLY NORMAL DENTITION A PAINLESS PROCESS.

In a perfectly healthy child, living in a perfectly healthy manner, the processes of the development of the teeth and of the absorption of the gums are precisely balanced, and the teeth finally perforate the gum without causing either pain or irritation, general or local, or, at most, the symptoms are of but little moment. There may be some increase in restlessness, some slight failure in appetite, some slight elevation in the temperature of the mouth, and nothing more. At times the only symptom is a local uneasiness, proved by the circumstance that the child constantly puts its finger, or some foreign body, into its mouth. These cases where the teeth appear without causing any disturbance, however, are not the most common in children subjected to the many depressing influences of large communities.

THE LOCAL AND CONSTITUTIONAL SYMPTOMS OF ABNORMAL DENTITION.

Should there be any want of balance between growth and absorption, the propulsive and resisting forces become antagonistic, and irritation must result. This irritation is not caused chiefly by the pressure of the advancing tooth on the gum as is so commonly supposed. I have no doubt that the great cause of irritation *is the downward* pressure of the root upon the nerves and vascular supplies of the pulp, which downward pressure is caused by the opposing gum.

This pressure must give rise to constant local pain, in other words, to bad toothache, and the result of this irritation and pain must be congestion and swelling of the gums, and this but tends to increase the induration of these opposing structures, and, in some cases, proves to be the cause of abscess over the crown of the tooth, or of ulceration.

In these cases of antagonism between the propelling and obstructing forces of dentition, however, not merely the local symptoms which I have just described, but also constitutional symptoms, varying but slightly from those which we have studied as attending even strictly normal dentition up to symptoms of the gravest character.

As a result, no doubt, of the idiosyncrasies of the infant, these symptoms vary, and are manifested in different individuals in some ways. In some cases the cerebro-spinal system is principally affected, causing at times restlessness, sleeplessness, headache, convulsions, paralysis, mental and moral aberrations, or affections of the special senses. In other cases the respiratory system suffers, causing cough, catarrh, bronchitis, pneumonia, or spasmodic croup. Again, it may be the alimentary canal which is affected, and the infant may exhibit nausea, vomiting, loss of appetite, or diarrhea. Or, should the kidneys and bladder be implicated, there may be irritable bladder, or temporary albuminuria. Finally, in some cases, the skin is chiefly affected, and the infant exhibits eczema, as the usual form of skin disease, although other kinds of cutaneous disorder are met with, such as acne, etc.

THE PERIOD OF DENTITION ONE OF MUCH DANGER.

The period of teething is undoubtedly one of great danger, and statistics show that many children die at this time. In some cases death occurs directly from the effects of teething, as in convulsions; in other cases, indirectly, as, for example, in whooping cough, or in cholera infantum.

It has been the fashion, in the last few years, with some writers, to ignore the influence of dentition upon the welfare of the infant either in health or disease. They declare that dentition, being a physiological process, *ought* not to be, and *is* not dangerous. They maintain that little either *local* or *general* irritation can be caused by the eruption of the teeth, since the *gum tissue* is comparatively insensible, and because *healthy* children cut their teeth without trouble or suffering. After the description which I have given you, it will be scarcely necessary to enter into any argument upon this subject. *Gestation* is a physiological function, and yet it is one which causes great perturbation in the system, and in constitutions not typically healthy may develop painful or dangerous or even fatal affections. And yet the uterine tissue which incloses the evolving embryo is almost destitute of sensibility, and most women give birth to their children without difficulty or danger.

DR. JAMES W. WHITE ON PATHOLOGICAL DENTITION

My friend, Dr. James W. White, editor of the *Dental Cosmos*, a practical dentist, as well as an alumnus of the medical department of the University of Pennsylvania, has written a most admirable paper on Pathological Dentition, which you will find in the American supplement of the April number of the *Obstetrical Journal* of Great Britain and Ireland for 1878. I quote largely from this paper, because it gives the opinion of a dentist of experience on this subject, who is also at the same time a physician of culture and judgment:

"The human mouth invites the study alike of the physiologist and pathologist, because of its importance to the physical welfare of the individual; because of its wonderful combinations in organization and of function; because of its topographical associations, and because of its intimate physiological and pathological relations to the entire system. Its various offices necessitate a no less varied structure, and an equally varied relation with other structures. Anatomically, no other portion of the human body offers such a complex association of tissues; physiologically, no such diversified functions; pathologically, no such significant systemic relations. The medium of aeration and alimentation; the organ of mastication, insalivation and deglutition; of speech and of music; endowed with the senses of taste and of touch to a high degree; the wide circle of its anatomical and physiological sympathies suggests an equal circle of pathological complications. Its direct relation by continuity of its lining mucous membrane with the pharynx, œsophagus, stomach, and intestinal tract, as well as with the larynx, trachea, and bronchi; its relation by continuity as well as by contiguity to the eyes, ears, and nares; its direct and sympathetic nervous relations, all indicate the diversity, as also the gravity, of the disturbances, radiated, reflex, or dependent upon systemic irritation to which its lesions may give rise.

"The terminal distribution of the sensory, as well as the motor branches of the great hypersensitive trigeminus, in and about the mouth; its extensive sympathetic connections, and their relation to the heterogeneous composition and manifold functions of the organs contained therein, are indicative not only of a high degree of nervous endowment, but of a liability to aberrations of sensation, nutrition, motion, and intellection, when these termini are the seat of disordered sensibility.

"If there be any force in these observations, they would seem to have special application to the formative and eruptive period of dentition—a period of augmented nervo-vascular action, and, like all such periods, liable to disturbance from pathological or morbid activity. The predominance of the spinal system in infancy is, moreover, strongly suggestive of the mischief which is likely to occur as the result of an eccentric irritation, the generalization of the local disturbance. The fact is not disputed that the period covered by the first dentition is that during which the greatest number of deaths occur among children."

THE DECIDUOUS TEETH AND THE ORDER OF THEIR APPEARANCE.

As we have already seen, the eruption of the teeth does not take place until some months after birth, and that it is preceded by symptoms such as salivation, which indicates that the whole alimentary system is preparing for the great change that the possession and use of the teeth involve.

The first teeth of the infant are called the deciduous or *milk* teeth, and are twenty in number—ten in each jaw. These twenty teeth are as follows: eight incisors, four in each jaw, the four being composed of two central and two lateral incisors. They are composed, I say, of eight incisors, four canine or cuspid teeth, two in each jaw, and eight molars, four in each jaw—the molars being called first and second molars, indicating their relative positions as well as the periods of their eruption. The deciduous teeth exhibit a certain order in their appearance not always strictly observed, yet nevertheless *usually* exhibited. The rule is that the teeth in the lower jaw precede the same class of teeth in the upper jaw by some weeks, but in some individuals exactly the reverse is the case, and the teeth in the upper jaw appear weeks before those of the same class in the lower jaw. Again, the rule is that the teeth appear in pairs, with an interval of variable length between the appearance of the pairs, but, not infrequently, two or three pairs develop simultaneously.

THE AMOUNT OF IRRITATION GENERALLY IN DIRECT RELATION TO THE NUMBER OF TEETH APPEARING.

As a rule, the amount of irritation exhibited bears a direct relationship to the number of teeth piercing the gums, but, owing to the difference of susceptibility of individuals, it may happen that a single tooth will cause more irritation in some children than the simultaneous eruption of several will in others.

The teeth generally appear in the following order: First, the central incisors of the lower jaw, followed by the central incisors of the upper jaw. Then come the lateral incisors of the lower jaw, and finally the lateral incisors of the upper jaw. After the incisors the first molars make their appearance without any very definite order as to upper and lower jaw, then the canine or cuspid teeth follow, and lastly, the posterior molars are cut.

THE PROCESS OF DENTITION AN INTERRUPTED ONE.

Nature, however, has wisely arranged that this process of teething—involving, as it does, such great changes and the possibility of so much nervous irritation—nature has arranged that this process shall not go on continuously and without interruption, but shall take place gradually, periods of rest being interposed between the periods of evolution of the several kinds of teeth. By this admirable arrangement the constitution of the infant is enabled to recover from the effects caused by the eruption of one pair of teeth before it is compelled to endure the trial of the eruption of the succeeding pair. Thus several weeks elapse after the first incisors appear before the last come through. Then the economy seems to take a rest, and three or four months pass before the first molars are seen. After the eruption of these first molars another pause of some weeks in duration occurs, and then the canine or cuspid teeth are cut. A *long* rest of some months now follows, and finally, the four posterior molars pierce the gums, and the process of first dentition is complete.

I may say, in a rough way, that the central incisors make their appearance from the fifth to the eighth month, and the lateral from the eighth to the tenth month. The first molars appear from the twelfth to the sixteenth month; the canine, from the fourteenth to the twentieth month; and the second molars, from the twentieth to the thirty-sixth month.

THE MANAGEMENT OF THE INFANT DURING TEETHING.

The important subject now presents itself: How shall a child be managed during dentition? Bearing in mind the perils which dentition implies, it is evident that even healthy children should be watched and guarded with special care during this critical epoch. If possible the infant should not be weaned from the breast until after the appearance of the canine teeth, which teeth always occasion more pain and irritation than any of the other deciduous teeth. The nursing infant, however, long before the eruption of these teeth, and, therefore, long before weaning, may be gradually accustomed to a varied diet by giving it cow's milk, prepared in a way that you all now understand, or chicken, veal, or beef soup. Chicken and veal soup are rich in gelatine, and, therefore, very desirable.

In this way the child's digestive organs, as I have just remarked, are gradually prepared for the total change of diet which must take place as soon as it is weaned.

Should the infant have been weaned, however, before dentition begins, or should it have been brought up from birth by artificial feeding, it will be much more liable to disorders of its digestive apparatus while cutting its teeth than a child fed exclusively, or almost exclusively, by the breast, and this fact must always be borne in mind in the management of such children.

ALL DISEASES MORE DIFFICULT TO TREAT DURING DENTITION.

During dentition all disorders of the nervous, respiratory, alimentary, and vascular systems—indeed, all diseases, must be treated upon general principles. It must never be forgotten, however, that all diseases may be more difficult to treat during the eruption of the teeth than before or after. And the question will constantly present itself in such cases: Is the affection from which the infant is suffering caused directly, or is it aggravated by the irritation of any tooth or teeth that may be in process of active evolution at the time? This question has been very extensively and acrimoniously discussed. It need not occupy us now, however, since I have already given you my reasons for holding that, in many cases, the backward pressure of the growing tooth or teeth becomes a potent cause of aggravation to any disorder which may affect the child at the time, and, in many instances, it is the sole and direct cause of the special trouble which the infant exhibits. If this be admitted, the conclusion is evident that this backward pressure must be relieved, or all other remedies will be inefficient or useless, and the relief is furnished by lancing the gum over the advancing tooth or teeth in a way that I shall presently show you.

LANCING IN SOME CASES A NECESSITY.—THE ARGUMENTS AGAINST IT CONSIDERED.

My friend Dr. White says: "The argument against lancing, that dentition cannot exert any special influence in the etiology of the diseases of infancy, because of the comparative insensibility of the gum tissue, and, because of the progressive growth of the tooth, is inadequate to make sufficient pressure to cause serious discomfort, finds answer in tumid, tense, and shining gums; in ulceration, in sloughs, and in the black, congested blood which sometimes follows a touch of the lancet; finds answer, too, in the relief following its intelligent employment—relief so immediate, so manifest, so complete, that the relation of cause to effect is apparent to every observer. The argument founded on the assumed increased resistance of cicatricial tissue is as unfounded as it is common. Cicatricial tissue is always of a lower degree of organization than the original structure, and, consequently, easier of absorption. The argument founded upon the danger of serious hemorrhage applies with equal force not only against every operation, but against all medication. . . . The argument based on the occasional necessity for a frequent repetition of the operation would apply with equal force as to any medication which fails to secure permanent relief in a given derangement, liable in the nature of things, or under special circumstances, to demand a repetition. The argument, which even professional men do not hesitate to use, that thousands of children erupt their teeth without recourse being had to the lancet, and the equally unmeaning boast of some that they have never used a gum lancet, are hardly entitled to serious notice. It may, however, be said, in reply, that thousands of women become mothers without the aid of a physician, and there are many practitioners who never used obstetric forceps. Are obstetricians and obstetric forceps, therefore, unnecessary? All arguments based on the probability or possibility of unfavorable results are more than offset by the consideration that many infants' lives are sacrificed yearly because of popular and professional prejudice against the lancet."

Fortunately, after a little experience, you can easily, in most cases, at once determine by examining the infant's mouth, whether the teeth are in fault, and which are the offenders.

* A recent lecture, delivered before the Medical Class of the University of Pennsylvania by Richard A. F. Penrose, M.D., Professor of Obstetrics and of the Diseases of Women and Children in the Medical School. (Specially reported for THE SCIENTIFIC AMERICAN.)

THE POPULAR PREJUDICE AGAINST LANCING.

There is much popular prejudice on the subject of lancing infants' gums. Some mothers will attribute all the ailments manifested by their infants during dentition to the growing teeth, and will consequently often almost insist upon having the child's gums lanced. Others, even in cases where lancing is urgently demanded, will obstinately refuse any suggestion of surgical interference, or will consent to it with great reluctance. The medical attendant must not, therefore, suffer himself to be biased by the opinions of those having charge of sick infants, and must act in every case as his judgment and experience shall dictate.

THE LECTURER'S RULE IN ALL SUCH CASES.

My rule, when called to see an infant sick during dentition, is always to examine its gums carefully, and, if I find any teeth nearly through, especially if I also find the gum over the tooth or teeth swollen, projecting, and purple, I lance the gums, invariably to my little patient's immediate relief from a badly aching tooth, if I do nothing else, and I usually also thus bring about immediate and often complete relief to the fever, restlessness, and other symptoms of nervous irritation which may constitute the child's indisposition, or may add greatly to its severity.

Very frequently, however, I am called to see sick children who are teething, but where there is no tooth that is causing much or any irritation. Perhaps the incisors are through, but the first molars have not begun to make much pressure upon the gums, or the incisors and first molars are through, but the canines are not making painful pressure. In such cases, when I make up my mind that the tooth or teeth coming out are not causing irritation, especially if I find that the gums do not present the peculiarities of color and swelling to which I have just referred, I do not use the lancet, even though the mother (as she often does) urges its application. Bear in mind that the gum lancet is to be used only to relieve a condition of irritation and of suffering that, if prolonged, may give rise to grave consequences. Recollect also, that it is not a matter of indifference whether you cut into a developing tooth follicle or not, particularly when the growing tooth is causing little or no harm to your patient.

THE RESULTS OF INJUDICIOUS LANCING.

I believe that when we lance into the follicle of a growing tooth too soon, we interfere, as a consequence of the division of many blood vessels, with the full nutrition, hence that its subsequent development is slower. And I believe that this explanation is the correct one, and accounts for the slow eruption of teeth that have been lanced too early and unnecessarily, and not that their subsequent slower development is due to a hard resisting cicatrice, to which it is usually attributed, since it is well known that cicatricial tissue, being of a lower organization, has less vitality and is more readily absorbed than the normal structures of the part.

I always tell mothers who urge me to lance the gums of their children, when I do not find any that I think requires lancing, that a premature or improper lancing always retards the final eruption of the tooth, and should always be avoided.

The only exceptions to this rule are in cases of certain grave nervous affections, such as convulsions, spasmodic croup, and other grave disorders of the central spinal system. In such cases it is not only proper, but often essential, that every tooth which can by any possibility be making any backward pressure shall be thoroughly lanced, and thus one great possible source of cerebro-spinal irritation be removed.

So much for the treatment of the first dentition—the cutting of the deciduous or milk teeth. Children often suffer a great deal of pain and uneasiness during the period of the eruption of the second teeth. At this time iron and other tonics will often be indicated. If nervous and cerebral symptoms predominate, it will also be necessary to administer bromides and other nervous sedatives.

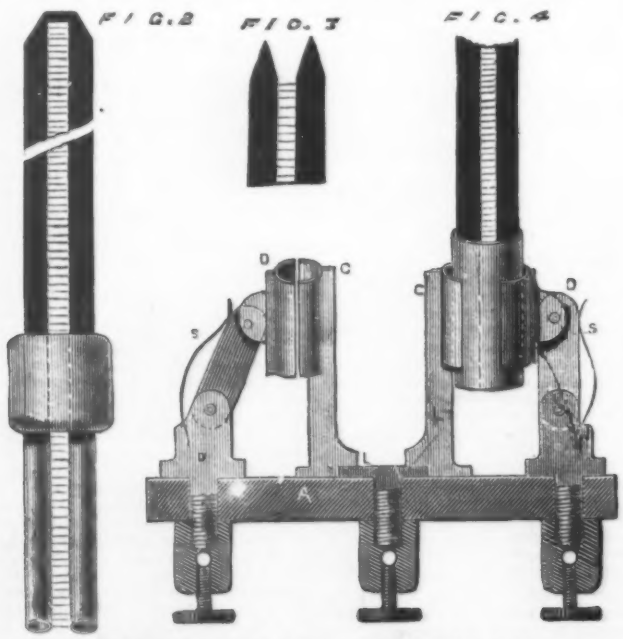
THE ELECTRIC LIGHT.

By J. T. SPRAGUE.

THERE is a great deal of misconception as to the true meaning of the problem called the divisibility of the electric light. This misconception will cost several inventors great waste of time and money, because they are directing their attention to and taking out patents for dividing the electric *current*, and distributing it to different lights, or candles. But this is not the real problem; it is not the electricity which requires division, but the *light-producing power* of the electricity. Any one with a small knowledge of electricity can devise any number of modes of dividing the current by shunts and resistances, and, as there is no novelty, there is nothing in them patentable, except possibly some particular construction of no more real value than a dozen others. The point is this—the conditions of the electric arc are such that it must produce an intense light or it will produce none at all. Then, of course, electricity obeys the same conditions as other lights; its mechanical equivalent or cost per unit of light is greater as the light produced is lessened. If we take the figures I used on p. 187, and assume that a light of some 1,000 candles involves the consumption of 13,200 ft. lb., or 13·2 ft. lb. per candle, what will be the consumption of energy in producing a light equivalent to, say, an Argand burner consuming 5 ft. of gas and giving 16 candles of light? Will it be 212 ft. lb.? Will it be double that amount, or may other conditions of generating light be arrived at which will, say, by developing a lower spectrum, and so economizing the production of ultra-violet rays, give more light for the same consumption of energy? *That is the problem of the divisibility of the electric light.* It will be readily understood, from the particulars given on p. 237, that the conditions of resistance and current in the arc are continually varying; the different lamps in which controlling mechanism is employed to regulate the distances of the carbons succeed in doing so only within a certain range of fluctuations; absolute uniformity is not possible, because the carbons will always consume somewhat irregularly. If, then, two or more arcs are placed in one circuit, as every variation of resistance anywhere in the circuit modifies the current, and every change in the current acts through the whole circuit, and so not only changes every light, but also causes every regulator to act alike, whether the actual conditions of its own arc require such action or not, it is clear that the more arcs there are in one circuit, the greater must be the irregularity in the lights. The object of these regulators is simply to maintain a uniform distance between the carbons which are being unequally consumed. This consumption, in the experiments of the Franklin Institute, is stated thus:—

Light in Candles.	Size of carbons. Square.	Consumed per hour. +	Consumed per hour. −	Grains of carbon p. hr. in. arc.	Grains of carbon p. hr. per candle	Wght. per inch.
1230	⅜ × ⅜	1·78	·34	76·7	·0623	36·2
900	⅜ × ⅜	1·91	·58	90·1	·1000	36·2
440	¼ × ¼	2·45	·73	64.4	·1463	20·2
705	¼ × ¼	3·15	·55	74·9	·1062	20·2
"Candle"	Sq. in.					
760	2· × ·02	3·	3·	45·	·0592	7·5

I have not at present the exact weight of these carbons, but from some trials I think it has a specific gravity of about 1·38, or a weight per cubic inch of 324 grains, which I have used in the above table in the calculations I have added to it of the consumption of carbon. The last line, relating to the Jablochkoff candle, I have arrived at as will be seen presently. With reversed currents of course the consumption of the two carbons is equal. In the Jablochkoff candle, as developed through a variety of stages, this fact is availed of, and instead of a regulating system, causing the carbons to approach as they are consumed, the carbons are fixed once for all at the desired distance, parallel to each other, and arranged to burn away equally, and thus maintain the desired equal arc. This is, however, not perfectly attained, owing to the inevitable irregularities in the composition of the carbons; consequently when 3 or 4 of these candles are in one circuit, any such disturbance in one of them is immediately propagated through the whole series, so causing much of the fluctuation observed.



THE JABLOCHKOFF ELECTRIC LIGHT.

The candle is shown full size (Fig. 2), except as to length, which is about 8½ in., of which the exposed carbon is 6½ in., about ·16 in. in diameter, and weighing about 7 to 8 grains per inch. Each candle burning 1½ hour, there are therefore—allowing for the parts left unburnt—about 9 in., or 6 in. per hour consumed, which may be taken to represent 45 grains of carbon, with a light claimed to be equal to 760 candles. The carbons are mounted in brass tubes, by which the contact is made, and separated by a layer of plaster of Paris, and at the lower end by a cement which surrounds the carbons and tubes and binds the whole together. A strip of plumbago and gum joins the upper ends of the carbons, and so enables the current to pass and form the arc; but if this is once extinguished there are no means of relighting the candle. The plaster of Paris becomes heated, and is then a partial conducter, carrying portion of the current, becoming vividly luminous; but whether its light holds a fair proportion to the current which it abstracts I cannot say. It seems probable, however, that to this cause may be due the diminished ratio of consumption of carbon to light manifested in the foregoing table. Among other ideas patented by M. Jablochkoff as sources of light, this incandescence of kaolin and plaster is claimed, and at the Paris Exhibition was shown a small light of intense vividness produced by passing the secondary current of an induction coil through or along the edge of a strip of plaster, along which it had to be carefully led in order to start the light.

As the candles burn each only 1½ hour, a lamp is used which contains four candles, with wires and a commutator at the foot of the lamp to throw the current into any desired one of the candles. Fig. 4 shows a section of the bottom of the lamp, and the mode of putting the candles in circuit. A is a slab of glass, or other insulating material, in the middle of which is a block of brass, B, with a binding screw at which the current enters—to it are connected four pillars, of which only two, C C, are shown, terminating in a clasp. Opposite to this is (for each candle) a jointed clasp, D, each with its binding screw. Springs, *s s*, press the two parts of the clasp together, so as to grip the candle, which is shown mounted on one side. Fig. 3 shows the form assumed by the ends of the carbons during the passage of the current. —*English Mechanic.*

SALT MINE ILLUMINATED BY ELECTRIC LIGHT.

THE experiment of lighting the Marston Rock Salt Mine, Cheshire, belonging to Messrs. Jos. Verdin & Sons, by the electric light was tried lately, the arrangements for lighting being placed in the hands of Messrs. Welch & Scott, Manchester. Up to this time rock salt mines, which are huge caverns formed by the quarrying away of the salt, this one being of seven acres in area, and supported on pillars formed from the salt, have always been lighted by what are commonly called farthing dips, each man carrying one. The result is almost perfect obscurity, and the men have great difficulty in handling the salt after it is quarried. On this occasion the Siemens machine was used, driven by a Marshall engine, and the result was that what are technically called the workings were lighted up like day. The effect was very fine on the newly quarried rock salt, which sparkled brightly in the rays. The experiment thoroughly proved the applicability of the electric light to the lighting of salt mines, and will doubtless before long come into general use for this purpose.

THE MIRROR OF JAPAN, ITS MAGIC QUALITY.

PROFESSOR W. E. AYRTON recently gave the Friday evening discourse at the Royal Institution, and began by referring to his residence in Japan for several years, in connection with the Imperial College of Engineering, and gave some interesting details of Japanese life, and more particularly of the high national estimation of the mirror, essential in every house, and its sacred character; the principal one in the palace being more reverenced than the Emperor himself. The mirror is termed "the soul of the woman," and every bride is expected to have two. The mythological history of the mirror was specially noticed. After exhibiting some magnified photographs on the screen illustrating the use of the mirror, he showed the so-called magic property possessed by some rare bronze Chinese mirrors, which consists in their being able to reflect, from their smooth polished surfaces, the raised patterns of birds, flowers, dragons, or letters, with which their backs are adorned. These mirrors have been known in China for centuries, yet but few Japanese ones possess this property. Various explanations have been given of this singular fact; and Sir Charles Wheatstone, as well as Sir David Brewster, attributed it to the maker skilfully scratching on the surface of the mirror, before polishing, lines exactly corresponding to the figures at the back. Professor Ayrton, after noticing other unsatisfactory explanations, described the experiments of his colleague, Professor Perry, and himself in 1877–8, which led to the discovery that there exists extremely slight irregularities in the curvature of the polished surface (quite invisible to direct vision), of such a nature that the thicker parts corresponding to the raised patterns at the back are flatter than the remaining convex surface, so that there is less dispersion of light from the thick portion than from the thinner. He then exhibited to his audience the optical phenomena of convergent and divergent beams of light; and explained, by a diagram, that if his theory of the phenomenon were correct, then, when the screen on which the reflection of the light from the mirror was cast was put in a certain position the phenomenon ought to disappear, and on putting the screen in another position the phenomenon ought to be inverted—that is, instead of there appearing a bright image on a dark ground, as had been observed by previous investigators, a dark image on a bright ground should appear. This was demonstrated by experiment most satisfactorily. He stated that after much trouble he discovered that the method by which the

Japanese made the face of the mirrors convex, hitherto unknown to foreigners, consisted in scratching the face while cold with a distorting rod. During the operation the mirrors became visibly concave, but spring back and became convex when the pressure of the rod is removed. The thicker part yields less and becomes less concave under the rod and less convex when it is removed. This explained Professor Atkinson's discovery, in 1877, that a small scratch on the back of a mirror made with a blunt nail, although producing apparently no effect on the other side, appeared as a bright line on the screen when a light was reflected from the mirror. In concluding, the professor said that while the Japanese were generally ignorant of the so-called magic quality of their mirror, the priests made use of a device for producing in the mirror, by the use of acids, figures which can only be seen by looking sideways, of which an example was exhibited.

AN ECONOMICAL ARRANGEMENT OF THE CALLAUD BATTERY.

By JOHN MORGAN.

I PREPARED two sets of Callaud Locals (two cells to each) with sawdust, in this manner: I placed the copper disk in its place, then filled the interstices with blue vitriol, pounded tolerably fine, level with the top of the copper. This required 2 lbs. and 2 ozs. of the vitriol for each cell. On the vitriol a pasteboard disk was placed fitting neatly. On this pasteboard disk I packed dry sawdust as tightly as I could, to a height of nearly three inches. Above this sawdust was placed another pasteboard disk, and above the latter the zinc. The cells were then filled with water to their proper line, and the next day placed in circuit on two of our sounders, on local wires, where a great portion of our business is transmitted. These cells worked *just as strong and far more regular* than those prepared in the usual way. In fact, there was *no* change in their regularity. They are removed from the instruments at least fifty feet, as the wires run. Nothing whatever was done to them during their continuance, excepting the replacing of the evaporated water. Had oil been used, probably even this little attention would not have been required. These cells lasted until the latter part of January, 1879, a period of *nearly* 14 *months*. The zincs were entirely consumed, but at least one-fifth of the blue vitriol remained in the cells *unused*. The consumption of blue vitriol, counting it as all consumed, averages a little less than 2½ *ozs. per cell per month*. Placing the cost of the vitriol at ten cents per lb. the cost would average 1 3-5 *cent per cell per month*. The zincs also lasted much longer than when set up in the regular way.

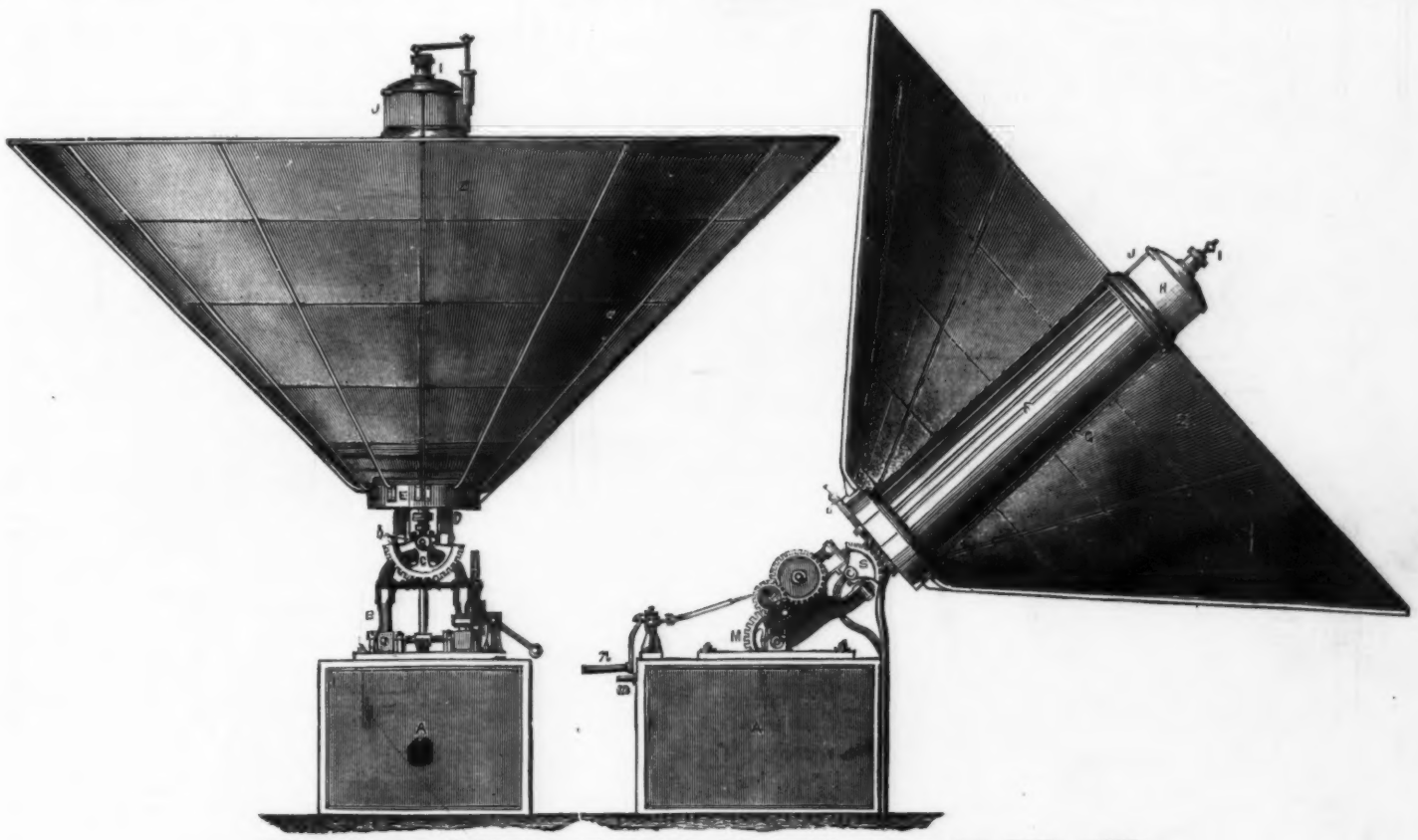
I have never tried cells filled in this manner in a main battery as yet, but from the perfect manner in which they performed *as locals*, I can see no reason why they would not act just as well in a main. It certainly has proved to be a great economizer of vitriol, zinc and labor, and as such, I place the facts before you, in the hope that they will assist still farther in reducing the expenses of the company in the way of battery material.—*Jour. of Telegraph.*

METALLIC CHROMIUM.—M. H. Moisson has presented to the Académie des Sciences a memoir on the amalgams of chromium, manganese, iron, cobalt and manganese, and on a new means of obtaining metallic chromium. To prepare the amalgams, a protochloride of one of these metals, in solution, is treated with sodium amalgam, when chloride of sodium and an amalgam of the metal employed are obtained. By distilling the chromium amalgam in a current of hydrogen, metallic chromium is obtained. Ordinarily this metal can be produced only by means of very high temperatures and somewhat lengthy manipulations; by the new process it may be obtained in a few hours. Chromium is attacked by boiling hydrochloric acid, but resists the effects of sulphuric and nitric acids. It would appear that, unlike the other metals mentioned, chromium amalgam cannot be obtained electrolytically by means of a mercury cathode.

SUN ENGINE.

THE utilization of the rays of the sun as a motor is by no means a novel idea; we will not say it is as old as the sun itself, but very early attempts have been made to convert the heat engendered by them into a substitute for fuel. Euclid, Archimedes, Hero of Alexandria, Solomon de Caus, Buffon, De Saussure, Ducarla, Pouillet, Franchot, Ericsson, and others, have added the results of their researches to the solution of the question in time past, and Ericsson in 1868 published analogous experiences in Philadelphia; but M. Mouchot, the well-known French *savant*, whose efforts commenced in 1861, has gone further than any one else in reducing the problem to a practical form in the large engine he exhibited near the aquarium in the Trocadéro grounds. In 1861 M. Mouchot gave the name of Heliopompe to his invention, and in 1865 he had several small engines of this description at work at Tours—Inde et Loire—and, without discussing the question of priority with reference to Ericsson's invention, we may here remark that, as a distinction of construction, M. Mouchot has avoided the use of parabolic mirrors and added a glass jacket to retain the heat. The engraving below will give a general idea of the principle of construction and the mode by which the rays of the sun are collected and utilized.

The apparatus is composed of a large conical mirror, Z, with rectilinear plates of silver-plated copper of very high reflecting power; of a tubular boiler, F, with blackened surfaces inclosed in a glass jacket, G, and of a special mechanism whereby the orientation, or setting to the east, of the apparatus, is made to follow the direction of the sun's rays. The mirror serves the double purpose of receiver and reflector. Instead of employing parabolic mirrors to concentrate the rays in one point, the conical mirror merely reflects them towards its own central axis. The boiler is placed in the focus of the mirror; the glass jacket permits the uninterrupted inward passage of the sun's rays, and prevents their radiation after they have been converted into obscure heat, by their contact with the blackened tubes.



MOUCHOT'S ENGINE, WORKED BY THE HEAT OF THE SUN.

The relative inclination to the latitude of the spot on which the apparatus stands having been, once for all, determined, it is only necessary to turn the handle, *n*, Fig. 2, which works the sector, C, Fig. 1, to produce the diurnal movement of the reflector; this can also be effected automatically. Referring to the drawing, A represents a masonry pedestal; B, Fig. 1, a stirrup-shaped support in cast iron turning on the shaft, *a*, by which the apparatus is arranged relatively to the latitude of the spot on which it is erected; C, Fig. 1, is a sector fitted on the shaft, *b*, by which the apparatus is made to follow the diurnal moment of the sun; D, Fig. 1, represents the cast iron standards which support the boiler and the reflector; E, Fig. 1, the framework to which the boiler and the skeleton of the reflector are attached; F, Fig. 2, the tubular boiler of plate iron; G, Fig. 2, the glass jacket; H, Fig. 2, the steam dome; I, the safety valve; at J is the steam gauge; *m*, Fig. 2, the screw which works the sector, M, for giving the latitudinal inclination; *n*, Fig. 2, the handle by which, through a train of geared wheels, the diurnal movement of the sector, C, Fig. 1, is actuated; and S, the sector fitted on the shaft, *r*, Fig. 2, worked by the screw, O, to alter the position of the boiler and reflector, according to the different solstitial angles in summer and winter. The extreme diameter of the reflector is about 5 meters; the area of the opening, therefore, about 20 square meters. The boiler—nominally, 3-horse power (?)—weighs, with its accessories, 440 lbs., with an extreme length of 8·20 ft., and a capacity of 44 gallons, or 3·53 cubic feet, 1·059 cubic feet of which is steam space, and the remainder, or 2·471 cubic feet, water. The usual time required to get up steam varies, of course, with the intensity of the sun's rays, the state of the atmosphere, etc., and is generally 1¼ hours for the first and 8 minutes for every succeeding 15 lbs. pressure; and adopting the data of September 22d as the result of mean autumnal influence, and as a fair criterion, we find that on that day a steam pump connected with the apparatus was lifting between 2,000 and 3,000 liters, or 4·000 gallons, per hour for a short time with a steam pressure of three atmospheres. The pressure has risen at times as high as seven and eight atmospheres; but, from our own observations, it was quite apparent that, owing either to the lateness of the season or to the imperfections of the boiler allowing steam to collect on the inner surface of the glass jacket and prevent the passage of the rays, to the leaky state of the pump, and consequent loss of power, or to whatever fortuitous circumstances it may be ascribed—although the initial pressure at starting was six and a half atmospheres—it sank so rapidly—viz., at about the rate of one atmosphere in every three minutes—that no reliance could be placed on the experiment as illustrating the practicability of the principle.

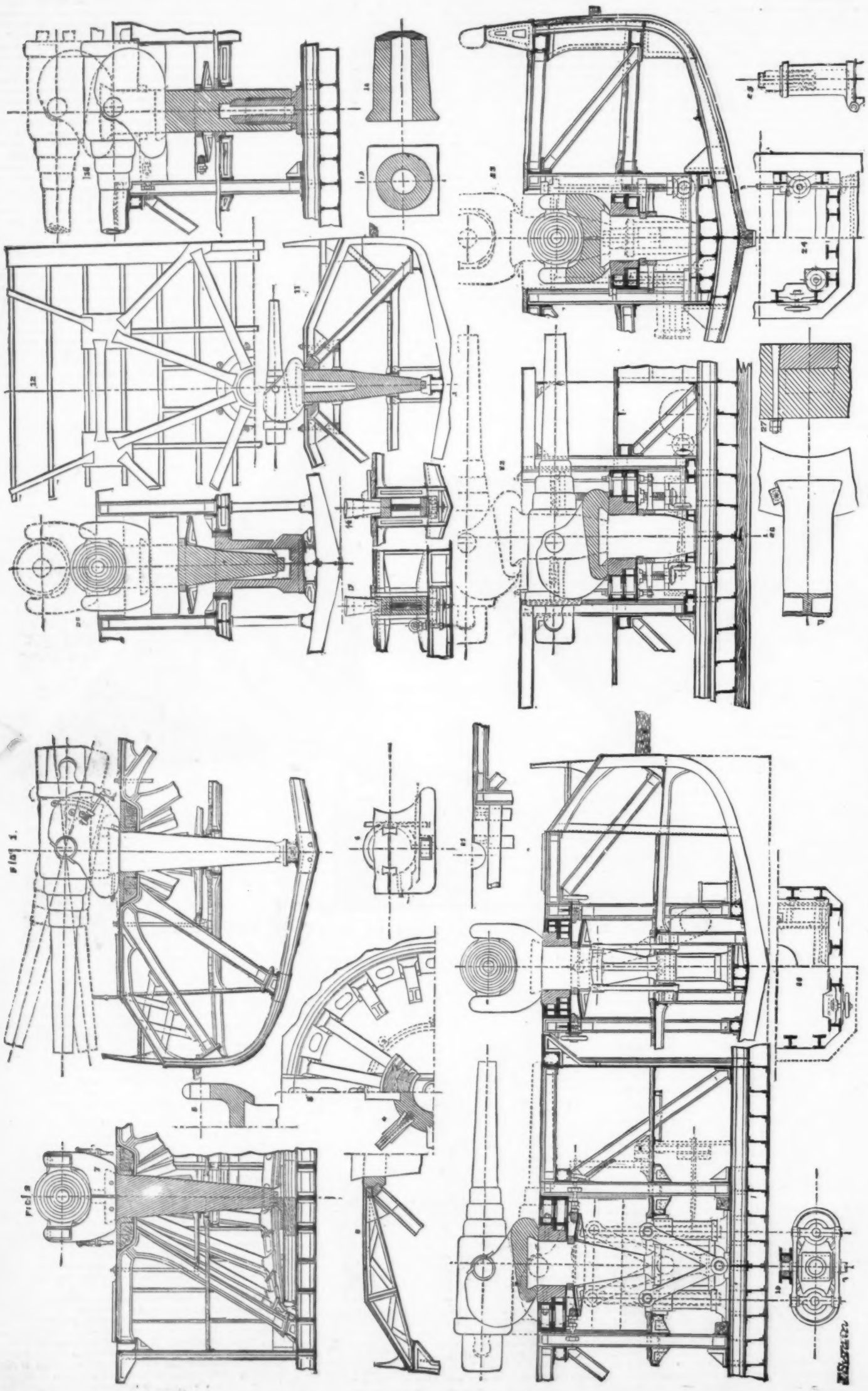
Whatever field may be open for the exploitation of sun engines in tropical and rainless countries where fuel is dear, we cannot look on the invention in its present state, and with existing results, as anything more than an ingenious toy. The hypothetical advantages claimed for it, by uniting several generators with a common steam reservoir, may possibly be realized and the effective power increased. The system proposed to raise sufficient water during the day to continue the night service of an engine may be possible, although scarcely feasible, or even the idea of accumulating heat for the evaporation of volatile compounds, such as ether, or decomposing water into its component gases by a combination with the solar-thermopile, and producing both heat and light, not beyond the pale of scientific research. Nevertheless, until more satisfactory practical results, over a longer space of time than the present engine has ever worked, have been obtained, we must abstain from sharing the sanguine expectations of the inventor. Too much haste had been shown in endeavoring to execute the work in time to show it before the close of the Exhibition, and whatever the causes of its imperfect success may be, it is neither advisable for the interests of the exhibitors, when seeking public recognition, to be obliged to apologize for and explain the reasons of its not fulfilling its expectations, nor to advertise its probable extensive application, until it has achieved the limited purpose for which it was constructed. Far be it from our task to judge the matter hastily or to depreciate the laudable efforts of the inventors, but we must, nevertheless, looking to practical and not to theoretical results for guidance, withhold our acquiescence in the favorable verdict passed on the desultory experiments by a large body of French *savants* who appear to have been too much impressed with its ingenuity to appreciate the absence of practical application.—*The Engineer.*

THE WALLED LAKE IN IOWA.

ACCORDING to the Dubuque *Herald*, the greatest wonder in Iowa, and perhaps any other State, is what is known as the "Walled Lake," situated in Wright County, 150 miles west of Dubuque City. The lake is from two to three feet higher than the surface of the surrounding land. In some places the wall is ten feet high, fifteen feet wide at the bottom, and five feet wide on the top. Another remarkable thing is the size of the stones used in constructing the wall. Stones are abundant in Wright County, but surrounding the lake for a distance of five miles there are none. No one can conjecture as to the means that were employed to transport the stones, nor as to who constructed the wall. Around the entire lake there is a belt of woodland half a mile in length, and composed of oak trees; with this exception, the country is a rolling prairie. The trees must have been planted there at the time of the building of the wall. In the year 1856 there was a great storm; the ice on the lake broke the wall in several places, and the farmers in the vicinity were obliged to repair the breaches to prevent an inundation.

The lake occupies a ground surface of 2,800 acres, and has a depth of 25 feet. The water is clear and cold; the soil sandy and loamy. It is singular that no one has as yet been able to ascertain where the water, which is always clear and fresh, comes from, or where it goes.

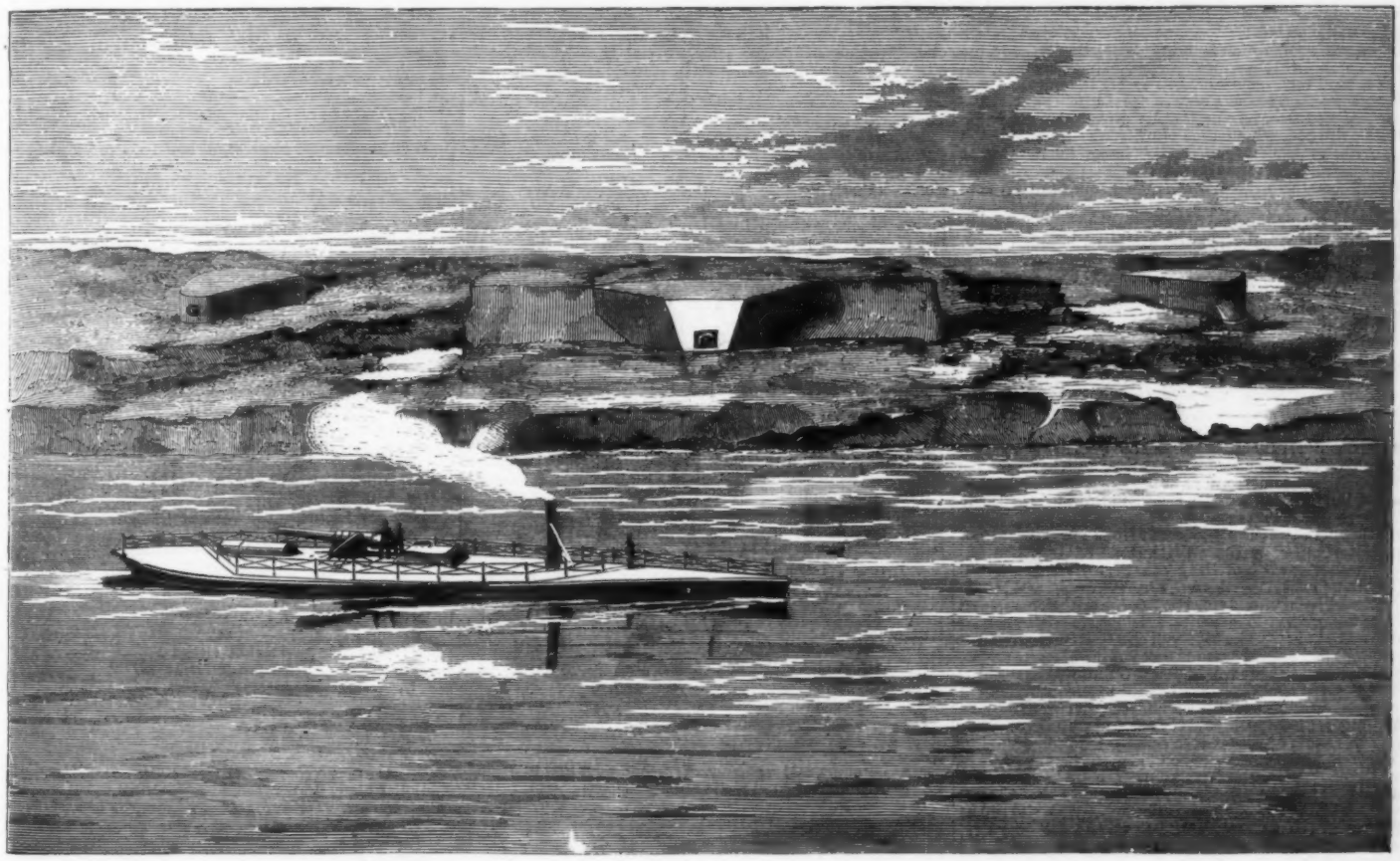
KRUPP'S IMPROVEMENTS IN WORKING HEAVY GUNS.



KRUPP'S HEAVY GUNS.

AN improved method of mounting ordnance, by Herr V. Krupp, is likely to attract considerable attention, especially as, we understand, plans for applying the system to vessels of small size are being laid before the British Admiralty. The method is essentially one for carrying a gun of considerable size on board a comparatively small vessel. The gun is trunnion pivoted, and is capable of being lowered below the vessel's deck for the purpose of stowage, or raised so as to be brought with its platform on the same level as the deck. The gun itself has no recoil, the shock being transmitted direct to the hull of the ship. The gun rotates with the pivot to which the carriage is attached, and is thereby capable of being directed to any point of the compass. In gunboats of the Staunch class, and such as were equipped by Sir W. Armstrong for the Chinese Government, the gun is only capable of being fired straight ahead. But by the method which Herr Krupp has now introduced, the gun has the advantage of an all-round fire, being trained quite independently of the boat. It thus offers to vessels of moderate size the peculiar merit of a turret-ship. The gun is not a disappearing gun, but the power of lowering beneath the deck will be of service in giving the vessel easier motion in heavy weather. The gun being deprived of recoil, can be more quickly loaded, and the readiness with which it may be turned would be of essential service in beating off torpedo boats. The gun is loaded by hand, and as there is no protecting turret or shield, a breech-loader would be advantageous, as affording some cover to the firing party, though it will be seen that shelter is furnished to some extent by means of hatches, or cap scuttles, fixed round the circle of the gun, so that there shall always be one or more in the rear.

We append a pictorial representation showing the application of the system to a gunboat of about 100 ft. in length, such as would be auxiliary to an ironclad, and would be engaged in beating off torpedo boats. Applying the system



KRUPP'S IMPROVEMENTS IN WORKING HEAVY GUNS.

on a larger scale, it is calculated that a 40 centimeter gun of 80 tons could be carried in an unarmored steel vessel of 1,000 tons displacement, with twin-screw engines of 4,000 effective horse-power, giving an estimated speed of 18 knots per hour. The vessel would be 200 ft. in length by 38 ft. in breadth, with 12 ft. as the extreme draught. The complement of men and officers would be fifty, and the estimated first cost of the vessel, ready for sea, without gun and stores, is £80,000. Such a craft is contrasted with broadside ironclads of the Minotaur, Agincourt, and Northumberland class, having a displacement of 10,500 tons, a length of 400 ft., and a speed of 15 knots, with guns of which the heaviest only fire a projectile of 300 lbs., while the first cost, without guns or stores, is £525,000. Of course, such ships are not built now; but in the next place comparison is made with the Inflexible, armored turret ship, of 11,500 tons displacement, a speed of about 14 knots, a length of 320 ft., and an estimated first cost, without guns or stores, of £476,000. The Inflexible is to carry four guns of 80 tons each, while one such monster piece of ordnance would be carried by the Krupp vessel of less than one-tenth the size and about one-sixth the cost. The Krupp vessel has two smoke-stacks carried abreast, and one of these can always be lowered to allow the gun perfect freedom in respect to its line of fire. Compared with the giant ironclads, the vessel thus designed and equipped appears but a diminutive antagonist, whereas it carries a gun equal to the heaviest in the British navy, and excels the Inflexible in speed. The power of rotating the gun is also complete, so that the smaller craft can fire "end on" with as much facility as a turret ship of large tonnage, and with even a more complete sweep of the horizon. Such are the merits of the new design, although, of course, it cannot vie in all respects with the first-class ocean-going ironclads of the present day.

In the view above it will be observed that as the vessel is not one of the larger type, there is only one smoke-stack. The one-gun batteries on shore are those in which the gun is muzzle-pivoted and completely covered, according to the plan of the "invulnerable gun" devised by Herr Krupp, and tried some time ago with marked success. The gunboat in this drawing might be armed with one long 6 in. gun weighing 3 tons. It is proposed that two smaller guns should also be carried, one at the bow and the other at the stern. Each of these might be the 8·7 centimeter field gun of 480 kilogrammes. A mitrailleuse could also be employed, probably the Nordenfelt or the Hotchkiss cannon. A twin-screw boat thus armed would be especially valuable for the purpose of encountering torpedo boats, as already mentioned.

Fig. 1, opposite, is a transverse section of a portion of a light draught gun vessel, Fig. 2 being a longitudinal section, and Fig. 3 part plan of the arrangement. A spindle or shaft, forged either solid or hollow, is shown in Figs. 9, 10 and 11, the head being either square or round to enable the cheeks, Figs. 5, 6 and 7, to be shifted to any position in the event of the head being damaged. These cheeks, forming the carriage, are made either of forged iron, soft cast steel, bronze, or other material found most desirable, the trunnions being placed in such a position that the rear part of the spindle may always be close to its bearings, and which are connected by means of dovetails, keys, screws, and wedges. The step or shoe, made of forged iron, or other material, is either secured to the keelson of the ship, or, where the depth of the structure allows, it may be secured and carried upon an intermediate deck. At the deck, or under the head of the shaft or spindle, support is given either by means of an armor-plate bush, backed with teak, or by hard wood chocks well secured to plate and angle iron carlings, as usual in shipbuilding. These carlings are carried by means of wrought H-iron struts, stepped upon keelsons and tie bars of flat iron worked under the deck plating—Figs. 1, 2, and 3—the whole being connected to the frames, floors, and beams of the ship, or by means of a solid bush or block of wrought iron or other material with friction rollers, or having a tight fitting turned ring let into the deck in two pieces, as shown in Figs. 11 and 12, and supported by H-iron sheets, flat tie bars, rods, and trussing dovetailed and keyed into it, as shown in plan and section, Figs. 4, 8, 11, 12, 26, and 27.

Figs. 1, 2, and 3 show a strong wrought or cast iron wheel secured to the spindle of the gun by keys or screw bolts, and turned by a pinion, worked either by steam, hydraulic, or hand power. The pinion shaft is prolonged through the upper deck to enable the gunner by means of keys or levers to bring the gun round and direct it to any desired point of the horizon. In the working of smaller guns the wheel may be fixed higher up, as shown in Fig. 11. It is proposed to place strong hatches or cap scuttles of wrought iron in the vessel's deck, as shown in Figs. 1 and 2, to prevent undue exposure of the men, and to facilitate the loading and sighting of the gun while in any position.

Figs. 13 and 14 represent in section and elevation a simple method of raising and lowering a small gun and carriage, suitable for small vessels, by means of a single screw, secured between the floors of the vessel or boat to a forging, above which is placed a guide block forming a nut with a step forged on the upper part to receive the heel of the spindle. This block is held in its place laterally by the guides, formed of plate and angle iron framing, and is made to rise and fall by a wheel and pinion. When the gun or platform is raised to the requisite height, a forged iron "fid" or key is passed through the aperture of the guide block, the screw is reversed half a turn, and the whole weight is then carried by the lower deck or platform.

Figs. 15 and 16 show the application of this system for raising and lowering guns of large caliber by means of one cylinder or ram, placed directly underneath the spindle. Fig. 15 is a transverse section showing a large hollow cylinder, the piston of which is well packed in the usual manner, and forms the step for carrying the spindle. When water or steam of sufficient pressure is applied on the under side of the piston the spindle rises to the requisite height, as indicated by the dotted lines, being steadied by means of guides, and carrying with it the gun, carriage, and platform, ready for working. The cylinder is then relieved of the load by the supporting clutches or blocks shown in Figs. 18 and 20, these blocks being screwed forward so as to pass underneath the platform by the action of the little wheels shown at the side. Fig. 16 is a longitudinal section of the vessel, showing a method for raising and lowering somewhat similar to that of Fig. 15, the means employed being one ram or cylinder, but with the bottom of the spindle formed hollow to enable a cylinder of less diameter and weight to be used. Where the depth of the vessel will permit, the cylinder or hydraulic ram can be placed entirely beneath the bottom end of the spindle, and thus modify the arrangement. In both the foregoing methods the bases of the cylinders are firmly secured to the keelson of the vessel, the upper end being supported by the beams and framing of the deck. The turning gear is disconnected by a lever crank.

Another application of this system consists in raising and lowering the gun and platform by two hydraulic rams or steam cylinders, the ram heads of which are kept apart by means of forged V-shaped flat links or bars, shown in Figs. 17, 18, and 19, connected and carried by stout crossheads, the water being admitted to the cylinders so as to raise both rams simultaneously. The spindle, when lowered, passes down between the cylinders, the heel being carried in a socket or step attached to a strong wrought iron table, under which a trunnion passes, connecting the links and guide blocks so as to secure a parallel motion, the head of the spindle being carried by a platform formed of stout H-iron and plate, having a wrought iron or cast steel bush or block firmly bolted to it, with turning gear on the under side, driven either by hand or steam power, as shown in Figs. 17 and 18. By means of clutches the same machinery may be used for working the pumps attached to the rams and cistern. Fig. 17 shows part longitudinal section, and Fig. 18 part transverse section of vessel. Fig. 19 is a plan of the rams or cylinders. In Fig. 20, part horizontal section of H-iron supports is shown, with plan of platform, spindle bush, and supporting clutches. Fig. 21 is a part transverse section of the vessel's deck, showing the recess made in it to carry the gun when lowered.

The adaptation of this arrangement to the present construction of composite vessels is shown as follows: Fig. 22 is part longitudinal section of the vessel and platform, showing the gun being raised or lowered by means of four continuous screws, worked simultaneously by bevel wheels, driven by means of hand or steam power. These screws are carried in strong forgings, firmly secured to the H-iron framing and supports, on the face of which are attached the slides for guiding the platform. On the bottom of the platform are secured strong forged crossheads extending from side to side, having nuts formed on their outer ends for connecting with the screws. Upon the bevel wheels being put in motion, the gun and platform rise to the fighting level indicated by the dotted lines. When the requisite height is reached, the supporting clutches are run out and the weight is carried by them, after which the hollow screw-jack, or column Fig. 25, is raised, secured, and screwed up in place underneath the spindle, thus relieving the screws and gearing. When the gun is again to be lowered, the screw-jack is swung down, as indicated by the dotted lines, the supporting clutches are withdrawn, and the motion of the screws is reversed.

Fig. 23 shows part transverse section of this vessel and the arrangements, and Fig. 24 part plan and horizontal section of the same. Figs. 23 and 24 also show a similar arrangement, worked by means of four hydraulic rams or steam cylinders, the ram heads of which are applied to the underside of the platform. Pipes and valves connect the cylinders, to insure uniform and simultaneous action of the pumps. Fig. 26 is a plan of the dovetail connection on a larger scale. Fig. 27 is a cross-section of the same in the wake of the wedge, key, or tightening bolt, one or more of

which may be used as found requisite, the object being in all cases to dispense with rivets as much as possible. Hence it is purposed to use sections of iron requiring little or no riveting.

When pneumatic power is employed to elevate and lower the gun, the weight in its descent may be made to compress a volume of air in chambers such as are used for holding compressed air, and this accumulated force may be supplemented by an additional supply of compressed air, held in one or more auxiliary vessels, and furnished by hydraulic or steam power. The details and arrangements thus given are shown as applicable to boats, vessels, and ships, but may be also applied to land forts or batteries, by substituting the level of the fort or battery for that of the ship's deck.—*The Engineer.*

THE ORE DEPOSITS OF LEADVILLE, COLO.

By Carl Henrich, E.M.

The principal ore deposits of Leadville are flat contact veins, between a silicious limestone for the foot-wall or bed-rock, and a trachytic white porphyry for a hanging-wall or roof. We will leave unsettled, at present, the question whether these ore deposits are contact veins or sedimentary deposits, formed after the underlying limestone and before the formation of the overlying porphyry, and proceed first to the topographical and geological position of these ore-beds.

The ore deposits of Leadville and vicinity are situated on the west slope of the Mosquito or Park Range. The lowest known outcrop is situated a hundred feet or more above the town of Leadville, on Carbonate Hill. This outcrop is, like nearly all the rest, covered with more or less deep detritus, formed mainly by broken porphyry masses. On this outcrop is situated, for instance, the Crescent mine. In this mine they have followed the ore-bed for about 500 feet into the hill, with an incline of about 15° pitch into the hill in an easterly direction. The ore-bed has continued for this distance very regularly excepting a few small faults or breaks of a few feet vertical height, always between a hard crystalline silicious limestone as bed-rock, and white porphyry for a roof, which is mostly immediately over the ore-bed decomposed to a white silicious clayish mass for the depth of several feet. Farther away from the outcrop, and higher up the hill, a recent strike in the Little Giant shaft, at a depth of 230 feet, has practically proven the continuation of this ore-bed, which theoretically was a settled fact long ago. A break-off of ore bodies along the outcrop of the Crescent mine, seemingly pitching to the west, down the hill, induced the owners or the managers of this mine to sink a shaft a few yards below the starting point of their incline; but, of course, they did not find anything, except at considerable depth, the face of a steep limestone bluff, covered with a thick body of porphyry detritus, through which they sank the shaft. This mistake and numerous prospecting shafts sunk into the wash between this outcrop and Leadville, some to a depth of 150 feet, prove conclusively that, instead of being covered by the not very steep slope of the hill, the outcrop of this ore-bed was once exposed on the top of the limestone in a high, steep bluff. This outcrop has been followed and discovered by numerous mines along the western slope of Carbonate Hill—by the Evening Star, Morning Star, Catalpa, Crescent, Yankee Doodle, etc.

This Carbonate Hill is situated on the north side of California Gulch, and separated from Fryer Hill, where the present Leadville bonanza mines are located, by Stray Horse Gulch. Following this ridge between California and Stray Horse gulches farther to the east, we reach, several hundred feet farther up and about a mile east of the lower outcrops, another belt of mines on the western slope of Iron Hill, indicating another outcrop of the contact vein. This ore-bed lies, like the lower one, between a silicious, crystalline limestone and a white, trachytic porphyry, decomposed just above the ore-bed to a white silicious, clayish mass of several feet thickness. The foot-wall and the hanging-wall of this upper ore-bed are the same as those of the lower one. We descend the incline of the celebrated Iron mine, walk down its gentle slope of about 15° into the hill to a length of about 400 feet, penetrate in its levels driven from this incline to the right and left for several hundred feet, and find everywhere the contents of this upper contact vein, or ore-bed, as similar to the contents of the lower ore-bed as might be expected in one and the same vein. Still we know by actual exploration and walking that the lower ore-bed should be several hundred feet below the outcrop of the upper one. Without bothering our heads further at present about this curiosity, we continue—after a visit to the neighboring mines, situated on the same outcrop, the Adlaide, the Camp Bird, the Silver Wave, and the Smuggler, etc.—our way eastward up the ridge and across Nugget Gulch, a side branch of California Gulch, past the head of Stray Horse Gulch, to the north of Oro City, nestled below us in California Gulch. On the other side of this gulch, to the south, we get a view of the shaft-houses of the Printer Boy lode, a formerly celebrated gold bearing fissure vein in porphyry. This vein has been followed from the top of the ridge between Iowa Gulch and California Gulch, a few hundred feet down below the level of California Creek, and abandoned on account of the inability at that time to treat the iron pyrites of the lower levels for gold, and on account of an influx of water from California Gulch making the working too expensive. That was in days gone by. Any way, we conclude, looking at these shafts opposite, that the porphyry on whose broken masses we stand extends a few hundred feet in depth below our feet; and so we continue our march higher up along the ridges, past the head of California Gulch, about half a mile above Oro City, and find ourselves now between Iowa Gulch to the south and Evans' Gulch to the north, at the foot of Bald Mountain, and near timber-line.

To the south of us, a little below timber-line, we discern the shaft and boarding houses of the Tiger mine and adjoining claims, owned or controlled and worked by our energetic friend Bauman; and before going farther and examining his Tiger, we partake of his hospitality in one of the best provided mining camps in this vicinity. After this, we descend into the Tiger shaft and drift, and discover a solid galena vein of eight to fifteen inches' thickness between porphyry walls, and opened up to a length of one hundred feet by a fine drift, the vein showing finely for the whole distance.

It has so far the appearance of a true fissure vein, improving in gold and silver materially as they have gained depth. As it is the intention of the company to sink as well as drift on its vein, we shall have a fine opportunity here of learning the thickness of the porphyry in this place; and the vein holding out, there is hardly any doubt that friend Bauman will find himself richly repaid for his energy, besides having a good thing on the Tiger vein proper, by striking a rich contact vein on reaching the bottom of the porphyry and the top of the underlying limestone. That they will reach the limestone here admits of hardly any doubt, as we see it cropping out on the hillside on the south side of Iowa Gulch in a large, thick ledge, pitching to the east. In this limestone ledge, near the top of it, is situated the celebrated Long & Derry, or Dana, mine, in which they are working a rich "stockwerk" in the limestone. That, at least, was the character of the ore deposit a few months ago, at the time of my visit to this mine. A more particular description of this, as of other prominent mines of this district, I reserve for future articles by myself or our friend Bauman.

After inspecting the Tiger, we continue our march farther east, and after passing the timber-line and over the porphyry covered summit of Bald Mountain, ascend to the top of the mountain between Bald Mountain and Dyer Mountain. Here on this mountain-top we come to an outcrop of black limestone, hard and crystalline, a little more regularly stratified than the one underlying the lower ore-beds and underlain by regular strata of clay schists and quartzite, under which the strata of gneiss crop out on the side of this mountain in Iowa and Evans gulches. This black limestone outcrop, pitching to the east at an angle of from 15° to 20°, crosses Dyer Gulch and crops out on all sides of the Dyer Mountain. We follow its outcrop along the head of Dyer Gulch, a northern branch of Iowa Gulch, and arrive, after some tall climbing, on the steep mountain sides at the celebrated Dyer mine, situated on the west slope of Dyer Mountain. This mine, like the Long & Derry, is in the limestone, not on top of it, as the lower ore-beds of the Crescent and Iron mines. The ore, high grade, here is contained in a network of small seams running in all directions through certain strata of this limestone, forming a kind of flat "stockwerk," which has been opened up by a few other good mines around Dyer Mountain besides the Dyer mine. Other mines are opened up all along this outcrop of black limestone. Above this limestone we pass over broken masses of porphyry over the top of Dyer Mountain, and so have here again porphyry covering the limestone. Opposite to us to the east, we have the precipitous face of Iowa Mountain, with its large rock-slides of broken porphyry and limestone before us, and we can trace clearly on its steep side the strata of black limestone capped with porphyry pitching to the east and north. Here we end our travel, fully six to seven miles from Leadville, and trace our way backward home down Iowa Gulch.

We have so far encountered in our journey four different outcrops of limestone, with porphyry above; but have, where it was possible to observe it, found always clay schists and gneiss underlying this limestone, and no porphyry below the limestone. We have observed two well-developed layers of ore between limestone and porphyry, and two ore deposits in limestone in two different outcrops of the same.—*Eng. and Mining Journal.*

RECIPES FOR DYEING.

By N. Spencer Thomas, Elmira, N. Y.

The following recipes for dyeing, in which Thomas' No. 33 forms an important part, are all obtained from practical dyers, and are the results obtained in some of the best dye houses.

In each recipe, advantages will be found that are very desirable on first-class goods, that cannot be had without Thomas' No. 33, as a brightness, fullness, and strength of color, and a fastness in fulling and a permanence in sunshine are had that can be obtained in no other way yet known in the art of dyeing. The coloring matter used being all fastened to the fiber by means of Thomas' No. 33, it is apparent that there is great economy in its use, as well as the advantages of superiority given to the colors.

No. 101.—Munjeet Red.

7 lb. clean wool,
1 lb. alum,
¼ lb. white tartar,
Enter wool and boil 1 hour and drain.
¼ lb. cudbear,
½ lb. Thomas' No. 33,
Boil 20 minutes, fill up until the heat is 120 degrees, and add
3 lb. munjeet.
Steep 2 hours and enter wool; bring to a boil in 1 hour, boil 10 minutes and draw off.

No. 102.—Crimson.

7 lb clean wool,
1 lb. cudbear,
½ lb. Thomas' No. 33,
Boil 20 minutes and add
2¾ ounces eosine,
Boil 5 minutes, enter wool and boil 1 hour; raise with 8 ounces alum, boil 1 hour and draw off.

No. 103.—Crimson.

8 lb. clean wool,
½ lb. cudbear,
½ lb. Thomas' No. 33,
Boil 20 minutes and add
3¼ ounces eosine,
Boil 5 minutes, enter wool, boil 1 hour and raise with
½ lb. alum.
Boil 1 hour and draw off.

No. 104.—Blue.

8 lb. clean wool,
2 ounces bichromate of potash,
1 lb. alum,
Enter wool and boil 1 hour, draw off and finish in clean tub with
1 lb. extract of indigo,
½ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour and draw off.

No. 105.—Blue Stain.

8 lb. clean wool,
2 ounces bichromate of potash,
1 lb. alum.
Enter wool and boil 1 hour, draw off and finish with
¼ lb. extract of indigo,
½ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour and draw off.

No. 106.—Lavender.

8 lb. clean wool,
1 ounce oxalic acid,
2 ounces alum,
Enter wool, boil 1 hour, draw off and finish with
¼ lb. logwood,
½ lb. Thomas' No. 33,
Boil 15 minutes, let liquor cool, enter wool, boil 10 minutes and draw off.

No. 107.—Crimson.

8 lb. clean wool,
1½ lb. cudbear,
½ lb. Thomas' No. 33,
Boil 10 minutes and add
1 ounce eosine,
Boil 5 minutes, enter wool, boil 1 hour and raise with
½ lb. alum,
Boil 1 hour and draw off.

No. 108.—Pink.

8 lb. clean wool,
¼ lb. cudbear,
½ lb. Thomas' No. 33,
Boil 10 minutes and add
½ ounce eosine,
Boil 5 minutes, enter wool, boil 1 hour and raise with
½ lb. alum,
Boil 1 hour and draw off.

No. 109.—Light Pink.

8 lb. clean wool,
2 ounces cudbear,
¼ lb. Thomas' No. 33,
Boil 10 minutes and add
1 ounce eosine,
Boil 5 minutes, enter wool, boil 1 hour and raise with
½ lb. alum,
Boil 1 hour and draw off.

No. 110.—Blue.

8 lb. clean wool,
½ lb. extract of indigo,
½ lb. alum,
½ lb. sulphuric acid (oil of vitriol),
½ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour and draw off

No. 111.—Blue Stain.

8 lb. clean wool,
¼ ounce extract of indigo,
½ lb. alum,
½ lb. sulphuric acid (oil of vitriol),
¼ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour and draw off.

No. 112.—Blue Stain.

8 lb. clean wool,
1 ounce extract indigo,
½ lb. alum,
½ lb. sulphuric acid (oil of vitriol),
¼ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour and draw off.

No. 113.—Blue Stain.

Same recipe as No. 114, except that Thomas' No. 33 is not used in No. 113. Samples of No. 113 and No. 114 show a great difference in favor of using Thomas' No. 33.

No. 114.—Blue Stain.

8 lb. clean wool,
2 ounces extract of indigo,
½ lb. alum,
½ lb. sulphuric acid (oil of vitriol),
¼ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour and draw off.

No. 115.—Blue.

8 lb. clean wool,
2 lb. extract of indigo,
½ lb. Thomas' No. 33,
Boil 10 minutes and add
½ lb. alum,
½ lb. sulphuric acid (oil of vitriol),
Enter wool, boil 1 hour and draw off.

No. 116.—Pea Green.

8 lb. clean wool,
2 ounces bichromate of potash,
½ lb. alum,
½ lb. argol,
Boil 1 hour, draw off and finish with
2 ounces extract of indigo,
¼ lb. fustic,
½ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour and draw off.

No. 117.—Sage.

8 lb. clean wool,
2 ounces bichromate of potash,
½ lb. alum,
½ lb. argol,
Boil 1 hour, draw off and finish with
1 ounce extract of indigo,
¼ lb. fustic,
½ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour and draw off.

No. 118.—Light Stain.

8 lb. clean wool,
½ ounce cudbear,
½ lb. Thomas' No. 33,
Boil 10 minutes and add
½ ounce extract indigo,
½ lb. alum,
½ lb. sulphuric acid (oil of vitriol),
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 119.—Extract Indigo Stain.

8 lb. clean wool,
¼ ounce cudbear,
½ lb. Thomas' No. 33,
Boil 10 minutes and add
½ lb. alum,
½ ounce extract of indigo,
½ lb. sulphuric acid (oil of vitriol),
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 120.—Blue Stain.

8 lb. clean wool,
1 ounce cudbear,
¼ lb. Thomas' No. 33,
Boil 10 minutes and add
½ lb. alum,
½ lb. sulphuric acid (oil of vitriol),
2 ounces extract of indigo,
Boil 10 minutes, enter wool, boil 1 hour and draw off.

No. 121.—BLUE DRAB.

8 lb. clean wool,
2 ounces cudbear,
1½ lb. Thomas' No. 33,
Boil 10 minutes and add
1½ lb. alum,
1½ lb. oil of vitriol,
2 ounces extract of indigo,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 122.—LAVENDER.

8 lb. clean wool,
¼ lb. cudbear,
1½ lb. Thomas' No. 33,
Boil 10 minutes and add
2 ounces extract of indigo,
1½ lb. alum,
1½ lb. oil of vitriol,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 123.—LAVENDER.

8 lb. clean wool,
½ lb. cudbear,
¼ Thomas' No. 33,
Boil 10 minutes and add
2 ounces extract of indigo,
1½ lb. alum,
1½ lb. oil of vitriol,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 124.—LAVENDER.

8 lb. clean wool,
2 ounces cudbear,
2 ounces Thomas' No. 33,
Boil ten minutes and add
1 ounce extract of indigo,
1½ lb. alum,
1½ lb. oil of vitriol,
Boil ten minutes, enter wool, boil 1 hour, draw off.

No. 125.—BLUE.

8 lb. clean wool,
1½ lb. Thomas' No. 33,
Boil 10 minutes and add
2 ounces bleu de Lyon, previously dissolved in
1 gill alcohol,
Boil 10 minutes and add
1½ lb. oil of vitriol,
Enter wool, boil 1 hour and draw off.

No. 126.—RED.

8 lb. clean wool,
1 lb. alum,
½ lb. argol,
Enter wool, boil 1 hour, draw off and finish with
¼ lb. purpurine,
½ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, bring to a boil in 1 hour, boil 10 minutes and draw off.

No. 127.—TAN BROWN.

8 lb. clean wool,
2 lb. fustic,
½ lb. Thomas' No. 33,
½ lb. madder,
Boil 30 minutes, enter wool, boil 1 hour and sadden with
½ lb. blue vitriol,
2 ounces alum,
Boil wool 1 hour and draw off.

No. 128.—BLUE STAIN.

25 lb. clean wool,
1½ lb. Thomas' No. 33,
Boil 10 minutes and add
¼ ounce bleu de Lyon dissolved in a little alcohol,
Boil 10 minutes and add
1 lb. alum,
½ pint oil of vitriol,
Enter wool of 100 degrees, boil 1 hour, draw off.

No. 129.—CRIMSON.

8 lb. clean wool,
1 lb. alum,
½ lb. argol,
Boil the wool 1 hour, draw off and finish with
1 lb. cochineal,
1 lb. cudbear,
½ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 130.—CRIMSON.

Same recipe as No. 129, omitting the Thomas' No. 33.

No. 131.—RED.

8 lb. clean wool,
½ lb. Thomas' No. 33,
Boil 10 minutes and add
¼ lb. fast red aniline,
Boil 5 minutes, enter wool, boil 1 hour and raise with
½ lb. alum,
Boil 1 hour, draw off.

No. 132.—RED.

8 lb. clean wool,
1 lb. alum,
½ lb. argol,
Boil wool 1 hour, draw off and finish with
½ lb. Thomas' No. 33,
Boil 10 minutes and add
2 ounces purpurine,
Boil 10 minutes, enter wool, bring to a boil in 1 hour, boil 20 minutes and draw off.

No. 133.—RED.

8 lb. clean wool,
¼ lb. cudbear
½ lb. Thomas' No 33,
Boil 20 minutes and add
2 ounces fast red aniline,
Boil 5 minutes, enter wool, boil 1 hour and raise with
½ lb. alum,
Boil 1 hour, draw off

No. 134.—CRIMSON.

8 lb. clean wool,
1 lb. alum,
½ lb. argol,
Boil wool 1 hour, draw off and finish with
1 lb. cochineal,
½ lb. Thomas' No. 33,
Boil 30 minutes, enter wool, boil 1 hour, draw off.

No. 135.—SALMON.

8 lb. clean wool,
4 lb. fustic,
½ lb. Thomas' No. 33,
Boil 20 minutes and add
½ lb. alum,
½ ounce eosine,
Boil 5 minutes, enter wool, boil 1 hour, draw off.

No. 136.—SALMON.

12 lb. clean wool,
3 lb. fustic,
½ lb. alum,
½ lb. Thomas' No. 33,
1 ounce cudbear,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 137.—SALMON.

12 lb. clean wool,
1½ lb. fustic,
½ lb. alum,
½ lb. Thomas' No. 33,
½ ounce cudbear,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 138.—SALMON.

12 lb. clean wool,
½ lb. fustic,
½ lb. alum,
¼ ounce cudbear,
½ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 139.—SALMON.

12 lb. clean wool,
¼ lb. fustic,
½ lb. alum,
½ lb. Thomas' No. 33,
⅛ ounce cudbear,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 140.—SALMON.

12 lb. clean wool,
¼ lb. fustic,
½ lb. alum,
½ ounce cudbear,
½ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 141.—SALMON.

12 lb. clean wool,
½ lb. fustic,
½ lb. alum,
½ lb. Thomas' No. 33,
1 ounce cudbear,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 142.—SALMON.

12 lb. clean wool,
1 lb. fustic,
½ lb. Thomas' No. 33,
½ lb. alum,
Boil 20 minutes and add
¼ ounce eosine,
Boil 5 minutes and cool, enter wool, boil 1 hour, draw off.

No. 143 —SALMON.

12 lb. clean wool,
2 lb. fustic,
½ lb. alum,
¼ lb. cudbear,
½ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 144.—ORANGE.

12 lb. clean wool,
4 lb. fustic,
½ lb. alum,
½ lb. Thomas' No. 33,
Boil 20 minutes and add
1 ounce eosine,
Boil 5 minutes, cool, enter wool, boil 1 hour, draw off.

No. 145.—Orange.

12 lb. clean wool,
¼ lb. flavine,
½ lb. muriate of tin,
½ lb. Thomas' No. 33,
Boil 10 minutes and add
½ lb. alum,
2 ounces eosine,
Boil 5 minutes, cool, enter wool, boil 1 hour, draw off.

No. 146.—ORANGE.

12 lb. clean wool,
¼ lb. flavine,
½ lb. muriate of tin,
½ lb. Thomas' No. 33,
Boil 15 minutes and add
½ lb. alum,
½ ounce eosine,
Boil 5 minutes, cool, enter wool, boil 1 hour, draw off.

No. 147.—ORANGE.

12 lb. clean wool,
¼ lb. flavine,
½ lb. muriate of tin,
½ lb. Thomas' No. 33,
Boil 15 minutes and add
1 ounce eosine,
Boil 5 minutes, cool, enter wool, boil 1 hour, draw off.

No. 148.—RED.

8 lb. clean wool,
2 ounces fast red aniline,
½ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour, and raise with
½ lb. alum,
Boil wool 1 hour, draw off.

No. 149.—BLUE.

8 lb. clean wool,
2 ounces camwood,
½ lb. Thomas' No. 33,
Boil 20 minutes and add
½ lb. sal soda,
1 lb. Guernsey blue,
Boil 10 minutes, enter wool, boil one hour, fish out and raise in clean bath with
11 ounces sulphuric acid (oil of vitriol),
Let stand 20 minutes at 190 degrees, draw off.

No. 150.—LOGWOOD BLUE.

250 lb. clean wool,
10 lb. alum,
5 lb. oxalic acid,
Boil wool 1 hour and finish with
100 lb. logwood chips,
Boil in bags 1 hour, take bags out, and add
2¼ lb. cudbear,
11 lb. Thomas' No. 33,
Boil 20 minutes and add
7 lb. sal soda,
Enter wool, boil 1 hour, draw off.

No. 151.—FUSTIC YELLOW.

50 lb. clean wool,
15 lb. chip fustic,
Boil 1½ hour, take bags out, and add
¼ lb. madder,
3 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, sadden with
1½ lb. alum,
Boil 1 hour, draw off.

No. 152.—LOGWOOD GREEN.

48 lb. clean wool,
¾ lb. bichromate of potash,
½ pint oil of vitriol,
½ lb. alum,
Boil wool 1 hour and finish with
14 lb. chip fustic,
1½ lb. chip logwood,
Boil 1 hour, take bags out, and add
3 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 153.—BLUE.

55 lb. clean wool,
1½ lb. bichromate of potash,
3 lb. alum,
Boil wool 1 hour and finish with
30 lb. extract of indigo,
1 lb. chip logwood,
3½ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 154.—ECRUE.

45 lb. clean wool,
3 ounces fustic,
2 ounces madder,
2 lb. Thomas' No. 33,
Boil 20 minutes and add
1 lb. alum,
Boil wool 1 hour, draw off.

No. 155.—TAN.

45 lb. clean wool,
5 lb. ground fustic,
4½ lb. madder,
2½ lb. Thomas' No. 33,
Boil 20 minutes and add
1 lb. alum,
Boil 5 minutes, enter wool, boil 1 hour, draw off.

No. 156.—BROWN.

215 lb. clean wool,
100 lb. chip fustic,
8 lb. chip logwood,
Boil 2 hours, take bags out, and add
12 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, and sprinkle
20 lb. camwood,
Boil 1 hour and sadden with
4½ lb. copperas,
2½ lb. blue vitriol,
2 lb. alum,
Boil wool 1 hour, draw off.

No. 157.—DRAB.

256 lb. clean wool,
8 lb. ground fustic,
8 lb. madder,
10 lb. Thomas' No. 33,
Boil 20 minutes, enter wool and sprinkle
6 lb. camwood,
Boil wool 1 hour and sadden with
2 lb. copperas,
¾ lb. argol,
Boil wool 1 hour, draw off.

No. 158.—GREEN.

40 lb. clean wool,
1 lb. bichromate of potash,
2 lb. alum,
Boil wool 1 hour and finish with
5 lb. fustic,
3 lb. Thomas' No. 33,
Boil 20 minutes and add
3½ lb. extract of indigo,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 159.—LOGWOOD BLUE.

50 lb. clean wool,
1 lb. oxalic acid,
2 lb. alum,
Boil 1 hour and finish with
12 lb. chip logwood,
Boil 1 hour, take bags out and add
6 ounces cudbear,
2½ lb. Thomas' No. 33,
Boil 20 minutes and add
2 lb. sal soda,
Enter wool, boil 1 hour, draw off.

No. 160.—TAN.

250 lb. clean wool,
15 lb. ground fustic,
11 lb. madder,
11 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, sprinkle
4 lb. camwood,
Boil 1 hour and sadden with
2½ lb. copperas,
2 lb. argol,
Boil wool 1 hour, draw off

No. 161.—DRAB.

25 lb. clean wool,
¼ lb. bichromate of potash,
¼ lb. alum,
¼ lb. argol,
Boil wool 1 hour and finish with
¼ lb. nutgalls,
1¼ ounce madder,
1¼ ounce logwood,
2 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 162.—ANILINE BLUE.

200 lb. clean wool,
2½ lb. Humboldt aniline dissolved in
3½ gallons alcohol,
Add the above mixture to the dye bath, boil 5 minutes and add
8 lb. Thomas' No. 33,
Boil 5 minutes, fill up the tub with cold water and add
3 quarts oil of vitriol,
Enter wool and boil 1 hour, draw off.

No. 163.—DRAB.

40 lb. clean wool,
1¼ lb. fustic,
1¼ lb. madder,
2 lb. Thomas No. 33,
Boil 20 minutes, enter wool and sprinkle
14 ounces camwood,
Boil wool 1 hour and sadden with
¼ lb. copperas,
2 ounces alum,
2 ounces argol,
Boil wool 1 hour, draw off.

No. 164.—GREEN TAN.

45 lb. clean wool,
8 lb. chip fustic,
1½ lb. chip logwood,
Boil 1 hour, take bags out and add
2½ lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour, and sadden with
2½ lb. blue vitriol,
Boil 1 hour, draw off.

No. 165.—DRAB.

20 lb. clean wool,
¼ lb. bichromate of potash,
¼ lb. alum,
¼ lb. argol,
Boil wool 1 hour, draw off, finish with
¼ lb. ground logwood,
11 ounces nutgalls,
¼ lb. cudbear,
3 ounces fustic,
5 ounces madder,
⅛ lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 166.—DRAB.

20 lb. clean wool,
¼ lb. bichromate of potash,
¼ lb. alum,
¼ lb. argol,
Boil wool 1 hour, draw off and finish with
1 ounce logwood,
8 ounces nutgalls,
½ ounce fustic,
2 ounces cudbear,
1 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 167.—OLIVE TAN.

90 lb. clean wool,
45 lb. chip fustic,
Boil in bags 1 hour, take bags out, and add
2 ounces logwood,
5 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, and sprinkle
1½ lb. camwood,
Boil wool 1 hour and sadden with
1¼ lb. copperas,
¾ lb. blue vitriol,
9 ounces alum,
Boil wool 1 hour, draw off.

No. 168.—DRAB.

20 lb. clean wool,
¼ lb. bichromate of potash,
¼ lb. alum,
⅜ lb. argol,
Boil wool 1 hour, draw off and finish with
½ lb. nutgalls,
½ ounce logwood,
1½ ounce madder,
1 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 169.—RED.

100 lb. clean wool,
15 ounces red aniline,
7 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour and raise with
5 lb. alum,
Boil wool 1 hour, draw off.

No. 170.—TAN BROWN.

30 lb. clean wool,
¾ lb. bichromate of potash,
¾ lb. alum,
¾ lb. argol,
Boil wool 1 hour, draw off and finish with
12 lb. chip fustic,
Boil 1 hour, take bags out and add
1¾ lb. madder,
1¼ lb. Thomas' No. 33,
Boil 20 minutes, enter wool and sprinkle
6 lb. red sanders,
Boil wool 1 hour, draw off.

No. 171.—ECRUE.

40 lb. clean wool,
13 ounces ground fustic,
5 ounces madder,
1¾ lb. Thomas' No. 33,
Boil 15 minutes and add
1¼ lb. alum,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 172.—YELLOW.

40 lb. clean wool,
11 ounces flavine,
2 lb. alum,
1½ pint muriate of tin,
3 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 173.—ECRUE.

40 lb. clean wool,
6 ounces fustic.
1 ounce madder,
2 lb. Thomas' No. 33,
Boil 15 minutes and add
¾ lb. alum,
1 ounce copperas,
Boil wool 1 hour, draw off.

No. 174.—GREEN.

70 lb. clean wool,
2 lb. bichromate of potash,
4 lb. alum,
Boil wool 1 hour and finish with
1 lb. chip logwood,
10 lb. chip fustic,
Boil 1 hour, take bags out and add
6 lb. Thomas' No. 33,
Boil 10 minutes and add
12 lb. extract of indigo,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 175.—LIGHT DRAB.

20 lb. clean wool,
¼ lb. bichromate of potash,
¼ lb. alum,
¼ lb. argol,
Boil wool 1 hour, draw off and finish with
10 ounces nutgalls,
1¾ ounces fustic,
¼ ounce logwood,
1 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, boil 1 hour, draw off.

No. 176.—ORANGE.

30 lb. clean wool,
1¼ lb. flavine,
6 ounces cochineal,
1½ lb. Thomas' No. 33,
Boil 10 minutes and add
2 pints muriate of tin,
Boil 10 minutes, enter wool, boil 1 hour, draw off.

No. 177.—BROWN.

250 lb. clean wool,
200 lb. chip fustic,
38 lb. chip logwood,
Boil 2 hours, take bags out and add
14 lb. Thomas' No. 33,
Boil 10 minutes, enter wool and sprinkle
40 lb. camwood,
Boil wool 1 hour and sadden with
8 lb. copperas,
4 lb. blue vitriol,
Boil wool 1 hour, draw off.

COTTON YARN DYEING.

No. 201.—DRAB.

10 lb. cotton yarn,
13 ounces Thomas' No. 33,
Boil 10 minutes, enter yarn at 150 degrees, go 15 turns, or 30 minutes, take out and wash and dry.

No. 203.—DRAB.

10 lb. cotton yarn,
13 ounces Thomas' No. 33,
Boil 10 minutes, enter yarn at 140 degrees, go 15 turns, or 30 minutes, take out, give 3 wrings.
Now get up a clean water at 150 degrees and add
1½ ounce bichromate of potash
Enter yarn, go 20 minutes, take out and wash and dry.

No. 204.—DRAB.

10 lb. cotton yarn,
10 ounces Thomas' No. 33,
Boil 10 minutes, enter yarn at 140 degrees, go 15 turns, or 30 minutes, take out and give 3 wrings.
3 lb. oak bark,
7 ounces ground logwood,
¾ lb. alum,
Boil in a clean water for 30 minutes, enter yarn at 140 degrees, go 30 minutes, wash and dry.

No. 208.—BLACK.

50 lb. cotton yarn,
10 lb. sumac,
3 lb. Thomas' No. 33,
Boil 15 minutes, enter yarn at 130 degrees, go 7 turns and sink over night, in the morning give 3 wrings, then run it through a liquor of ¼ lime liquor and ½ water for 10 minutes, take out and give 2 wrings.
5 lb. copperas,
Dissolve in clean water at 100 degrees, enter yarn, go 3 turns, take out and give 2 wrings, run it again through lime liquor, same strength as before, for 10 minutes, take out and give 3 wrings.
22 lb. logwood,
3 lb. fustic,
Boil in clean water for 30 minutes, enter yarn at 130 degrees, go 15 minutes, lift up, and add to same liquor
½ lb. copperas,
Enter yarn again, go 4 turns, take out and wash and dry.

No. 209.—DRAB.

64 lb. cotton yarn,
5 lb. cutch,
2 lb. Thomas' No. 33,
¼ lb. logwood,
2 lb. fustic,
Boil 30 minutes, enter yarn at 130 degrees, go 30 minutes and lift up and add to same liquor
½ pint iron liquor,
Enter yarn, go 15 minutes, take out and give 3 wrings.
¼ lb bichromate of potash,
Dissolve in clean water at 150 degrees, enter yarn, give 5 turns, take out, wash and dry.

No. 210.—DRAB.

10 lb. cotton yarn,
⅝ lb. fustic,
¾ ounce logwood,
¼ ounce hypernic,
5 ounces sumac,
2 ounces Thomas' No. 33,
Boil 30 minutes, enter yarn at 130 degrees, go 30 minutes and lift up, and add to same liquor
2 ounces alum,
6 ounces copperas,
Enter yarn, go 30 minutes, take out and wash and dry.

No. 211.—DRAB.

35 lb. cotton yarn,
2 lb. fustic,
½ lb. alum,
1 lb. cutch,
1 lb. Thomas' No. 33,
Boil 20 minutes, enter yarn at 130 degrees, go 15 minutes and lift up and add to same liquor
¼ lb. blue vitriol,
¼ lb copperas,
Enter yarn again, give 7 turns, take out, wash and dry

No. 212.—DRAB.

70 lb cotton yarn,
4 lb. cutch,
2 lb. Thomas' No. 33,
9 ounces blue vitriol,
Boil 20 minutes and add the strength of
9 ounces ground logwood,
Enter yarn at 130 degrees, go 40 minutes, take out and give 3 wrings,
1 pint iron liquor,
Mix the iron liquor in clean cold water, enter yarn, give 7 turns, take out, wash and dry.

No. 213.—TAN BROWN.

47 lb. cotton yarn,
12 lb. cutch,
4 lb. Thomas' No. 33,
1¼ lb. blue vitriol,
Boil 30 minutes, and add the strength of
4 lb. fustic,
Enter yarn at 180 degrees, go 1 hour, take out and give 2 wrings,
1 lb. bichromate of potash,
Dissolve in water at 130 degrees, enter yarn, go 20 minutes, take out and wash and dry.

No. 214.—LIGHT OLIVE.

12 lb. cotton yarn,
¾ lb. cutch,
¼ lb. Thomas' No. 33,
2 ounces blue vitriol,
Boil 30 minutes, enter yarn at 180 degrees, go 10 minutes, take out and give 2 wrings,
½ lb. bichromate of potash,
Dissolve in clean water, enter yarn at a boil, give 7 turns, take out and wash and give 3 wrings,
3½ lb. fustic,
¾ lb. logwood,
Boil 30 minutes in clean water, enter yarn at 130 degrees, go 30 minutes, then lift and add to same liquor
¼ lb. blue vitriol,
¼ lb. sal soda,
Enter yarn again, give 12 turns, take out, wash and dry.

No. 215.—DRAB.

13 lb. cotton yarn,
4 lb. cutch,
2 lb. Thomas' No. 33,
1 lb. blue vitriol,
Boil 20 minutes, and add the strength of
½ lb. logwood,
Enter yarn at 200 degrees, go 1 hour and lift up, and add to same liquor
5 ounces copperas,
Enter yarn again, go 15 minutes, take out and wash and give 3 wrings,
7 ounces bichromate of potash,
Dissolve in clean water, enter yarn at 190 degrees, give 7 turns, take out, wash and dry.

No. 222.—BLACK.

100 lb. cotton,
15 lb. Thomas' No. 33,
15 lb. extract of logwood,
Boil 10 minutes, or until thoroughly dissolved, enter cotton at 190 or 200 degrees, steep 2 hours, fish out and drain,
6 lb. soda ash,
2 lb. blue vitriol,
Dissolve together in clean water and add to first liquor, enter cotton at a boil, let stand 2 hours, fish out and dry.

No. 223.—BOTTOM FOR INDIGO (SLATE BLUE).

100 lb. cotton,
5 lb. Thomas' No. 55,
10 lb. Thomas' No. 33,
Mix in cold water, enter cotton, bring slowly to a boil in 2 hours, draw off.

No. 224.—BLACK.

100 lb. cotton,
25 lb. extract of logwood,
10 lb. Thomas' No. 33,
Boil 10 minutes, or until thoroughly dissolved, enter cotton at 190 or 200 degrees, steep 2 hours, fish out and drain.
5 lb. blue vitriol,
15 lb. soda ash,
Dissolve together in clean water at 100 degrees, enter cotton, let stand 1 hour, and fish out.
If color is not full enough enter cotton again into the dye liquor, then if not full enough enter again into mordant liquor.
Save both the above liquors, adding only half the quantity of all the drugs for second and future operations.

No. 225.—PURPLE.

100 lb. cotton,
20 lb. Thomas' No. 33,
2 lb. alum,
Dissolve in water, enter cotton cold, and bring to a boil in 30 minutes,
2 lb. Spiller's purple, No. 2,
Dissolve in 5 gallons boiling water and boil until all dissolved, add enough water to cover cotton, enter cotton cold, bring to a boil and boil 1 hour, lift out and add
5 lb. nitrate of iron,
Enter cotton again and boil 30 minutes, draw off and dry.

No. 226.—SILVER DRAB (ON COTTON OR WOOL).

50 lb. cotton (or wool),
5 lb. Thomas' No. 33,
Dissolve in sufficient water to cover, enter cotton (or wool) at 150 to 175 degrees, bring to a boil and boil 1 hour, sadden with
1 lb. copperas,
Let stand from 1 hour to 2 hours and draw off.
Various shades may be made by changing proportions of fiber to dye stuff.

No. 227.—DRAB.

50 lb. cotton,
15 lb. Thomas' No. 33,
1½ lb. Thomas' No. 44,

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Boil in water 10 minutes, or until thoroughly dissolved, enter cotton, break the cotton thoroughly to have color go on evenly, boil 1¼ hour, then sadden with
2¼ lb. copperas dissolved in a pail of hot water, pole thoroughly,
Boil 30 minutes, and if shade is dark enough draw off; the shade will darken by lying in the liquor a few hours; if not dark enough add more of the Thomas' No. 44.

No. 228.—STAIN.

50 lb. cotton,
15 lb. Thomas' No. 33,
1½ lb. Thomas' No. 44,
Boil in water 10 minutes, or until thoroughly dissolved, enter cotton, break the cotton thoroughly to have color go on evenly, boil 1½ hour, if shade is dark enough draw off; the shade will darken by lying in the liquor a few hours; if not dark enough use more of the Thomas' No. 44.

No. 229.—STAIN.

50 lb. cotton,
5 lb. Thomas' No. 33,
5 ounces alum,
Boil in water 10 minutes, or until thoroughly dissolved, enter cotton, break the cotton thoroughly to have color go on evenly, boil 1 hour, then sadden with
5 ounces copperas dissolved in hot water,
Pole thoroughly, boil 30 minutes, and if shade is dark enough draw off; the shade will darken by lying in the liquor a few hours; if shade is not dark enough use larger quantity of all the drugs.

WOOL DYEING.

No. 301.—BLUE.

100 lb. clean wool,
10 lb. Thomas' No. 33,
Boil 10 minutes or until thoroughly dissolved, enter wool at 175 degrees, boil 45 minutes and draw off.
1 lb. 4 B Nicholson blue,
1 lb. sal soda,
Dissolve the blue and the soda in separate waters, and when the blue is thoroughly dissolved mix the two liquors, in this mixture enter the wool at 175 degrees and bring to a boil, let stand 2 hours, then wash in clean cold water, then in
250 gallons clean water, mix
3 pints oil of vitriol,
Enter wool at 175 degrees and bring to a boil, let stand 1 hour and draw off; to vary the shade change the proportion of wool used, always keeping same proportions of No. 33, aniline, and sal soda, and keeping the acid liquor same strength.

No. 302.—BLACK.

100 lb. clean wool,
3 lb. bichromate of potash,
½ pint oil of vitriol,
Enter wool, boil 1½ hour and drain, finish in fresh water with
45 lb. logwood,
4 lb. fustic,
Boil in bags 1 hour, take bags out and add
12 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1½ hour; to let lie in liquor over night is an improvement.

No. 303.—BROWN DRAB.

150 lb. clean wool,
50 lb. chip fustic,
Boil in bags 1 hour, take bags out and add
6 lb. Thomas' No. 33,
Boil 10 minutes and add
21 lb. madder,
4 lb. red tartar,
Boil 5 minutes, enter wool and sprinkle in
60 lb. camwood,
8 lb. ground logwood,
Break the wool until even, boil 1½ hour, and sadden with
6 lb. copperas,
Boil 30 minutes; it will improve by lying a few hours in the liquor before drawing off; wash off.

No. 304.—DARK BROWN.

150 lb. clean wool,
8 lb. bichromate of potash,
2 lb. blue vitriol,
3 lb. red tartar,
Boil 10 minutes, enter wool, have it well broken up and boil 1¼ hour; if convenient let lie a few hours; draw off and drain, finish in fresh water with
25 lb. extract of fustic,
6½ lb. Thomas' No. 33,
Boil until thoroughly dissolved, enter wool and sprinkle in
90 lb. barwood,
10 lb. ground logwood,
Break the wool thoroughly, boil 1¾ hour, and sadden with
4½ lb. copperas,
Then boil 45 minutes; it will improve by lying a few hours in the liquor before drawing off; wash off.

No. 305.—DARK SLATE.

50 lb. clean wool,
15 lb. Thomas' No. 33,
1¼ lb. Thomas' No. 44,
Boil until all dissolved (say 5 minutes), enter wool, pole up until thoroughly broken, boil 1¼ hour, then sadden with
2½ lb. copperas, dissolved in 1 pail boiling water,
Boil wool 30 minutes, and if shade is dark enough draw off; if let lie in liquor a few hours it will become darker in shade; if wanted still darker use more of the Thomas' No. 44.

No. 306.—SILVER DRAB.

50 lb. clean wool,
5 lb. Thomas' No. 33,
Boil 5 minutes, enter wool at 175 degrees, boil 1 hour and sadden with
1 lb. copperas, dissolved in 1 pail boiling water,
Boil 30 minutes, and if wanted of darker shade let stand a few hours; if wanted still darker a larger proportion of the drugs must be used.

No. 307.—STAIN.

50 lb. clean wool,
5 lb. Thomas' No. 33,
5 ounces alum,
Boil 5 minutes, or till all dissolved, enter wool and break well with poles, boil 1¼ hour; if shade is dark enough draw off; if wanted darker let lie a few hours.

No. 308.—DARKER STAIN.

50 lb. clean wool,
5 lb. Thomas' No. 33,
5 ounces alum,
Boil 5 minutes, or till all dissolved, enter wool and break well with poles, boil 1¼ hour and sadden with
10 ounces copperas dissolved in boiling water,
Boil wool 30 minutes; if wanted darker let lie in liquor a few hours; if wanted still darker use larger quantity of all the drugs.

No. 309.—LIGHT OLIVE.

50 lb. clean wool,
1 lb. bichromate of potash,
5 ounces red tartar,
Boil 10 minutes, enter wool, break well with poles for 20 minutes, then boil 1¼ hour, let lie in liquor a few hours, draw off and drain.
7½ lb. ground fustic,
3 lb. Thomas' No. 33,
Boil 20 minutes, enter wool, break well with poles, boil wool 1¼ hour; if dark enough draw off; if wanted darker let lie in liquor a few hours.

No. 310.—DARKER OLIVE.

50 lb. clean wool,
1 lb. bichromate of potash,
5 ounces red tartar,
Boil 10 minutes, enter wool, break well with poles for 20 minutes, then boil 1¼ hour, let lie in liquor a few hours, draw off and drain.
7½ lb. ground fustic,
Boil 20 minutes and add
5 lb. madder,
3 lb. Thomas' No. 33,
Boil 5 minutes, enter wool, break well with poles, boil wool 1¼ hour; if dark enough draw off; if wanted darker let lie in liquor a few hours.

No. 311.—BROWN OLIVE.

50 lb. clean wool,
5 lb. ground fustic,
2½ lb. Thomas' No. 33,
Boil 20 minutes and add
7½ lb. madder,
Boil 5 minutes, enter wool, break well with poles until even, boil 1½ hour, then sadden with
¾ lb. copperas dissolved in hot water,
Use poles again, boil 30 minutes, then if dark enough draw off; it will darken by lying in the liquor a few hours.

No. 312.—SCARLET.

100 lb. clean wool,
15 lb. Thomas' No. 33,
2 lb. alum,
Boil 5 minutes, enter wool at 175 degrees, boil 1½ hour, draw off and drain,
1 lb. No. 1 scarlet,
2 lb. alum,
Dissolve the 1 lb. No. 1 scarlet and the 2 lb. alum in separate waters, boiling the scarlet till entirely dissolved, mix the solutions and add
1 pint muriate of tin,
Enter wool cold, bring slowly to a boil, and boil from 1 to 2 hours, draw off and dry.

No. 313.—DRAB.

50 lb. clean wool,
5 lb Thomas' No. 33,
5 ounces alum,
Boil 5 minutes and add
5 lb. madder,
5 ounces red tartar,
Boil 5 minutes, enter wool, break well with poles until even, boil 1½ hour, then sadden with
¾ lb. copperas dissolved in hot water,
Use poles again, boil 30 minutes, then if dark enough draw off; it will darken by lying in the liquor a few hours.

No. 314.—BLUE.

50 lb. camels' hair (or wool),
1½ lb. bichromate of potash,
1½ lb. alum,
½ lb. oxalic acid,
Enter camels' hair (or wool), use poles for 20 minutes, then boil 1½ hour, and draw off and drain, finish with
22½ lb. chip logwood,
Boil 1½ hour in bags, take bags out and add
2 lb. Thomas' No. 33,
Boil 5 minutes, enter camels' hair (or wool), break well with poles, boil 1½ hour and let stay in liquor 4 or 5 hours.

No. 315.—DARK BLUE.

Same as No. 314, using
10 ounces copperas to sadden with.

No. 316.—DRAB.

Same as No. 313, leaving out the saddening with copperas.

No. 317.—BLACK.

100 lb clean wool,
3 lb. bichromate of potash,
1 lb oil of vitriol,
Boil wool 1½ hour, draw off and drain, and finish with
50 lb. chip logwood,
Boil in bags for 1½ hour, take bags out and add
8 lb. Thomas' No. 33,
Boil and rake well for 5 minutes, enter wool at 180 degrees, and boil 1½ hour, draw off and dry.

No. 318.—OLIVE BROWN

50 lb. clean wool,
1½ lb. bichromate of potash,
½ lb. blue vitriol,
½ lb. red tartar,
Enter wool, break well with poles, boil 1¼ hour, and let stay in liquor 3 or 4 hours, draw off, drain and finish with
24 lb. chip fustic,
1½ lb. chip logwood,
Boil in bags 1½ hour, take out bags and add
3 lb. camwood,
5 lb. Thomas' No. 33,
Boil 10 minutes and add
10 lb. madder,
Boil 5 minutes, enter wool, break well with poles and boil 30 minutes, then sadden with
½ lb. copperas dissolved in hot water,
Use poles again, boil 30 minutes; if dark enough draw off; by lying in liquor a few hours the shade will be darker.

No. 319.—BLACK.

50 lb. camels' hair (or wool),
2 lb. bichromate of potash,
½ lb. alum,
½ lb. red tartar,
Enter camels' hair (or wool), break well with poles, boil 1¼ hour, and let stay in liquor 3 or 4 hours, draw off, drain and finish with
50 lb. chip logwood,
6 lb. chip fustic,
Boil in bags 1½ hour, take bags out and add
4 lb. Thomas' No. 33,
Boil 10 minutes, enter camels' hair (or wool), break well with poles, boil 1 hour and sadden with
1 lb. copperas dissolved in hot water,
Use poles again, boil 1 hour, draw off; shade will improve by lying in liquor a few hours.

No. 320.—BROWN.

50 lb. clean wool,
1½ lb. bichromate of potash,
1 lb. alum,
1 lb. red tartar,
Enter wool, use poles till wool is well broken, boil 1½ hour, draw off and drain, and finish with
18 lb. chip fustic,
Boil in bags 1½ hour, take bags out and add
3 lb. camwood,
5 lb. Thomas' No 33,
Boil 10 minutes, and add
10 lb. madder,
Boil 5 minutes, enter wool, break well with poles and boil 30 minutes; if dark enough draw off; by lying in liquor a few hours the shade will darken.

No. 321.—BLUE BLACK.

50 lb. clean wool,
¾ lb. bichromate of potash,
3 lb. alum,
1 lb. oxalic acid,
Enter wool, break well with poles, boil 1¼ hour, and let stay in liquor 3 or 4 hours, draw off, drain and finish with
25 lb. chip logwood,
6 lb. chip hypernic,
Boil in bags 1½ hour, take bags out and add
5 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, break well with poles, and boil one hour, and sadden with
1 lb. copperas dissolved in hot water,
Use poles again, boil 1 hour and draw off; shade will improve by lying in liquor a few hours.

No. 322.—BLUE BLACK.

50 lb. clean wool,
1 lb. bichromate of potash,
6 lb. alum,
2 lb. oxalic acid,
Enter wool, break well with poles, boil 1¼ hour, and let stay in liquor 3 or 4 hours, draw off, drain and finish with
20 lb. chip logwood,
Boil in bags 1½ hour, take bags out and add
5 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, pole well, boil 1 hour, and sadden with
1 lb. copperas dissolved in hot water,
Use poles again, boil 1 hour, draw off; shade will improve by lying in liquor a few hours.

No. 323.—DRAB.

50 lb. clean wool,
1½ lb. cudbear,
3 lb. ground logwood,
¾ lb. nutgalls,
¾ lb. alum,
½ lb. red tartar,
2 lb. ground fustic,
¾ lb. camwood,
2½ lb. Thomas' No. 33,
Boil 15 minutes and add
1 lb. madder,
Boil 5 minutes, enter wool, break well and boil 1¼ hour, then sadden with
1 lb. copperas dissolved in hot water,
Use poles again and boil 45 minutes and draw off; if not dark enough let stand 2 or 3 hours and draw off.

No. 324.—DRAB.

50 lb. clean wool,
2¼ lb. ground fustic,
2 lb. ground logwood,
½ lb. nutgalls,
3½ lb. Thomas' No. 33.
6 ounces red tartar,
Boil 15 minutes and add
4¾ lb. madder,
Boil 5 minutes, enter woo', break well, and boil 1¼ hour, then sadden with
1¼ lb. copperas dissolved in hot water,
Use poles again, boil 45 minutes and draw off; if not dark enough let stand in liquor 2 or 3 hours, then draw off

No. 325.—DRAB.

50 lb. clean wool,
1 lb. 7 ounces ground logwood,
1 lb. 7 ounces ground fustic,
½ lb. nutgalls,
1 lb. camwood,
3 lb. Thomas' No. 33,
Boil 15 minutes and add
5 lb. madder,
Boil 5 minutes, enter wool, break well, and boil 1¼ hour, sadden with
1 lb. copperas dissolved in hot water,
Use poles again, boil 45 minutes, draw off; if not dark enough let stand in the liquor 2 or 3 hours, then draw off.

No. 326.—SLATE.

50 lb. clean wool,
5¼ lb. ground logwood,
4 lb. Thomas' No. 33,
2½ ounces cudbear,
2½ ounces nutgalls,
10 ounces ground fustic,
½ lb. alum,
½ lb. red tartar,
Boil 15 minutes and add
1¾ lb. madder,

Boil 5 minutes, enter wool, break well with poles, boil 1¼ hour, and sadden with
1 lb. copperas dissolved in hot water,
Use poles again, boil 45 minutes, draw off; if not dark enough let stand 2 or 3 hours, then draw off.

No. 327.—DRAB.

50 lb. clean wool,
5 ounces ground fustic,
18 ounces ground logwood,
2 lb. 2 ounces Thomas' No. 33,
6 ounces red tartar,
Boil 15 minutes and add
2 lb. 5 ounces madder,
Boil 5 minutes, enter wool, break well and boil 1¼ hour, then sadden with
13 ounces copperas dissolved in hot water,
Use poles again, boil 45 minutes and draw off; if not dark enough let stand 2 or 3 hours and draw off.

No. 328.—BROWN DRAB.

50 lb. clean wool,
3 lb. ground fustic,
1 lb. ground logwood,
5 lb. camwood,
Boil 30 minutes and add,
¼ lb. sumac,
6 lb. madder.
2 lb. Thomas' No. 33,
Boil 5 minutes, enter wool, break well with poles, boil 1¼ hour, sadden with
10 ounces copperas dissolved in hot water,
Use poles again and boil 1¼ hour; if not dark enough let stand in the liquor a few hours, draw off and dry.

No. 329.—BLUE.

250 lb. clean wool,
10 lb. 4 B Nicholson blue,
1 lb. borax,
Boil 10 minutes and add
7 lb. Thomas' No. 33,
Boil 5 minutes and add
4 lb. sal soda,
Boil 5 minutes, enter wool at 200 degrees, boil slowly for 1½ hour, draw off, wash and extract water; spring in clean liquor at 190 degrees with
6 quarts oil of vitriol,
Let stand 30 minutes, draw off and wash; where much is done there is great economy in keeping a standing tub for the blue.

No. 330.—BLACK.

250 lb. clean wool,
6 lb. bichromate of potash,
1 pint oil of vitriol,
Enter wool and boil 1 hour, draw off and finish with
18 pails chip logwood,
7 lb. Thomas' No. 33.
Boil 1¼ hour, enter wool, boil 1 hour, let stand all night, draw off.

No. 331.—BLUE BLACK.

350 lb. clean wool,
9 lb. bichromate of potash,
Enter wool, boil 1 hour, draw off and finish with
221 lb. chip logwood,
Boil in bags 1½ hour, take bags out and add
10 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1½ hour; to let stand over night is an advantage.

No. 332.—DEEP BLACK.

300 lb. clean wool,
9 lb. bichromate of potash,
Enter wool, boil 1 hour, draw off and finish with
180 lb. chip logwood,
Boil in bags 1½ hour, take bags out and add
12 lb. Thomas' No. 33,
Boil 10 minutes, enter wool, boil 1½ hour; to let stand over night is an advantage.

Note by the Author.—The foregoing recipes will be sent GRATIS to ALL PURCHASERS of Thomas' Concentrated Dye Stuffs. They are all from practical and experienced dyers, and are believed to be very desirable; most of them have been submitted to full working tests, and found to be all that is desired as to superiority, permanency, and economy.

It is believed that the best results will appear in those recipes calling for the largest proportion of the No. 33, the proportion used in some of the recipes being rather too small for best results.

Criticism of the recipes and suggestions for their improvement are invited from all users.

More recipes will be added, on supplemental sheets, as received.

Users of these recipes with Thomas' No. 33 will confer a favor on the trade by forwarding to the author for publication such new recipes as they may discover are useful.

MALLEABLE BRASS.—The brass alloy in most common use is probably that containing about 65 copper, 33 zinc, and 2 lead or tin. This compound works well in the lathe, and can be rolled, but is very imperfectly malleable. Recently, a brass has been manufactured which possesses entirely novel properties, and can be forged at a red heat precisely like iron, so that it becomes applicable for many purposes for which ordinary brass is unsuitable. The new alloy, it is said, is composed of 57 copper, and 43 zinc; it should contain neither lead nor tin.

A CONDENSER OF VARIABLE CAPACITY.—Mr. C. V. Boys thus describes the condenser he designed to show the effect of condensation in the spark: "A glass tube is sealed at one end, and is covered with tinfoil for one-third of its length; this forms the outer coating. The inner coating consists of a test-tube with the rim cut off, also covered with tinfoil; this is fixed to a wire, and can be drawn in and out. When it is fully in, the condenser has its maximum capacity; when drawn out as far as possible, the two coatings are too far apart to have any sensible action, and the capacity is zero. On hanging this on the conductor of a Holtz machine the effect on the spark is well shown. Let the wire be first pushed in as far as possible, the condenser then acts to its full extent; but on gradually drawing it out the sparks are less and less bright, but follow one another more and more rapidly, till at last, when it is fully out, they have passed gradually to the almost continuous pale spark so characteristic of a Holtz machine. To show the effect best, the poles should not be more than about half an inch apart. Of course, much ozone is formed inside the tube."

THE SILK INDUSTRY OF NORTHERN ITALY.

By E. T. BLAKELY, F.S.S.

THE vast importance of the silk industry from a national, industrial, and artistic point of view cannot by any possibility be over-estimated. What the tea plant is to China and the Himalayas, the coffee and cinnamon to Ceylon, the vine to France and Germany, the hop gardens to Bavaria and Kent, such is the silkworm to Northern Italy. The growth of the mulberry, the nurture of the worm itself, the unwinding of the delicate gauzy substance from the cocoon, the spinning and twisting the same into a glossy and elastic thread—wherein the perceptive faculties of the workers are brought into activity—the wealth represented by the accumulated bales of silk rendered into a condition for barter, the numerous transactions between the merchant and his home or foreign clients, the monetary operations upon the exchange wherein the banker plays a considerable part, the reflux of capital in return for the exports to the foreigner and the consequent addition to the wealth of the country; when we consider these varied points of interest, either separately or in combination, and reflect upon the effect of their ramifications, it is not surprising that the cities of Northern Italy have for many centuries maintained a historic pre-eminence; or, that the slopes of the mountains and the borders of the lakes, where the silkworm has found a congenial home, should present the appearance of a garden cultivated with the utmost care that science and art give to the embellishment of nature.

The Chinese appear to have been the first cultivators of the mulberry for feeding silkworms, and they are supposed to have discovered the art of making silk 2,700 years B. C., in the reign of the Emperor Hong, whose empress, Si-ling-chi, is said to have first observed the labors of the silkworms on the mulberry trees, and applied their silk to use. From China the art passed into Persia, India, Arabia, and the whole of Asia. The caravans of Seres or Serica (the part of China where the silk was most abundantly produced) performed long journeys of 243 days from the "far coasts" of China to those of Syria. Aristotle was the first European to learn the true origin of the wrought silk brought to him from Persia on the return of the victorious army of Alexander from that country. He describes the silkworm as a horned insect passing through successive transformations, and producing *bombykia*, the name he gives to the silk. With the increase of wealth and luxury in the Grecian Court, the demand for silks augmented prodigiously. The Persians for a time engrossed the trade of Greece, and became rich from the commerce of silk, which they procured from China. The ancient Phœnicians also engaged in the traffic of silk, and carried it to the east of Europe, although in ignorance of the country whence their supply was drawn. From Greece it passed into Rome, and though the exact year of its introduction is unknown, it was probably about the time of Pompey and Julius Cæsar, the latter, we find, having used it in his festivals. The demand for silken articles rapidly increased under the Emperors, in spite of all prohibitions and restraints, and so great was the drain of specie from the Eastern Empire on account of silk and other Eastern productions, that the Emperor Justinian resolved to introduce the cultivation of silkworms into Europe; and encouraged by his promises and gifts, two Persian monks succeeded, about A. D. 550, in carrying the eggs of these insects to Constantinople. The Greeks soon acquired great skill in the production of raw silk, and carried on its manufacture at Thebes, Corinth, and Argos, and other places in the Peloponnesus, undoubtedly deriving their designs from the cotton and linen, if not silk looms of Al Modayn, Alexandria, Tabriz, Damascus, Tyre, and Antioch. The manufacture was subsequently carried by the Saracens from Bagdad, Tabriz, Aleppo, and Alexandria into Sicily, and examples are extant of the Saracenic silks of Sicily of the 12th century. Roger, King of Sicily, also carried a large number of silk manufactures from Greece to Palermo, in A. D. 1147. In another hundred years the manufacture of silk had extended to Lucca, and thence, about sixty years later, to Venice, Florence, Milan, Genoa, and Bologna. The manufacture of silk goods was brought from Lucca to Lyons, probably as early as the 15th century, but it made little progress until the silk culture and the production of the cocoons and raw silks were established at the beginning of the 17th century. In England the manufacture had made a little progress in the 15th and 16th century, but all attempts at silk culture had failed. In Austria, Germany, Switzerland, and the Low Countries there were manufactories of silk, but very little silk was grown.

The decline of the pre-eminence in the manufacture acquired thus early in Italy has been more than counterbalanced by great success in the cultivation of the mulberry, the diffusion and multiplication of the silk worm, and, in consequence, the enormous abundance of the silk which is annually collected. Thus, if the preparation of the tissues have suffered in certain localities, where the art was formerly very active, as a compensation the silk operations have been carried out upon a scale which all the countries in Europe combined together cannot equal.

Thus the yield of cocoons in 1876 was not quite 37 per cent. of that of 1875, the yield in raw silk being 38 per cent. of that of the previous year. In 1877 the yield of cocoons was calculated at 22,450,000 kilos, or one-third more than in 1876. The yield of raw silk, according to the figures compiled by the Cavaliere Pasquale de Vecchi, and published by the *Sole* newspaper for the same year, was 1,853,400 kilos. These returns are considered thus far reassuring, since they are greatly in excess of the previous year, 1876, although they only show one-half of the ordinary harvest previous to the disease in the worm.

The silkworm is reared principally by the peasantry in their own dwellings, and the cocoons are either sold direct to the proprietors of the filatures, or are disposed of at the country markets; in fact, a regular traffic exists in the article. This is apparent from the frequency of carts laden with the cocoon sacks that may be seen passing along the roads in the silk districts. The worm is described as being very voracious, allowing the peasant no rest at the period of its incubation, as the supply of the mulberry leaves requires to be constant and unfailing. There are, however, large silk-breeding establishments, and I am indebted to Vice Consul Kelly for a description of an establishment belonging to Signor Susani, at Albiate, in the Brianza. On rising ground, in the midst of his own estate, in a charming country, not far from the picturesque banks of the Lambro', Signor Susani, a gentleman of independent fortune, has arranged his Cascena "Pasteur," not in one block, but in scattered buildings, according to the modern hospital system, to avoid the spread of infectious diseases. Great attention is paid to warming, ventilation, and cleanliness, but all arrangements are made for practical use, without any attempt at outward show. It was in the midst of the breeding season when our visit was paid, and we found Signor Susani busily engaged in inspecting some dead worms, and noting down in a special register the cause of death, and the date of their decease. We were most cordially received, and visited in detail the whole establishment. The worms are carefully attended to by bright-looking peasant girls, who feed, change the beds of, and watch over their charges with the most careful solicitude.

To prepare cellular grain for the market, three years are required. The first year each couple of moths being placed in a coarse muslin bag, are carefully examined under a microscope after depositing their eggs; if no germs of disease are discovered their eggs are reared the second year, the product of every pair in a separate division, so that their characteristics can be thoroughly studied. In a register, or regular stud book, all particulars of birth, existence, and death are noted, each family under its numbers. The moths from these worms, after coupling and depositing their eggs, are also examined under the microscope, and the third year their grain is reared in two or three healthy sets of eggs together, the same care as before being taken in their registration. The grain produced from these worms, if all has gone well, is ready for sale for the following season. The qualities of silkworms to which Signor Susani pays the greatest attention are the yellow Brianza breed and Japanese reproductions.

Two qualities of grain are produced at Albiate, the "cellular" and the "commercial," the latter being prepared with less care than the first. The prices fixed for the season of 1878 were as follows:

	Per ounce of 25 grammes.
	lire c. lire c.
Cellular grain:—	
Japanese reproductions	11 70 to 16·00
Italian (Brianza)	19·00 to 21 00
Commercial grain:—	
Japanese reproductions	8·00 to 9·00
Italian (Brianza)	12·00 to 15·00

or even at lower rates, according to the quantity purchased.

There are three interesting epochs for a visit to Albiate—during the breeding season, when the moths couple, and during their examination under the microscope. The amount of work to be got through may be surmised from the fact that at the busiest season, though only for a short time, 1,000 women are sometimes employed.

The difference, as I am informed by a silk grower, between the "commercial" and "cellular" grain, consists in that the first is prepared in the ordinary manner, after a number of microscopic observations of moths, proving that the whole number, or the greater portion, are without corpuscles. For example, from a bulk of 1,000 kilos of worms, from which it is intended to obtain eggs, take off at hazard 200 or 300 cocoons, then hasten the coming forth of the moths by warming, and examine one by one their blood under the microscope. If it is found that all such are free from corpuscles, it may be concluded of the bulk that 90 per cent. are good, 70 per cent. middling, and less than 50 per cent. bad. The "cellular" system consists in separating each couple of moths, male and female, in order to obtain as many deposits of eggs as there are couples. Each couple is afterward examined by the microscope, and if the inspection proves their healthy condition, the corresponding deposits are adjudged good, and if on the contrary, they are rejected. Many persons think it sufficient to examine the female, while others believe the inspection of both sexes indispensable.

The complaint among the silkworms at the period of its greatest intensity caused much distress among the peasantry, who depend much upon the vine and the mulberry. The Indian corn, or *grano turco*, as it is called, is the daily food in the form of polenta, while the fig tree furnishes the dessert. There is a peculiar system called the "mezzadria" which exists in the province of Bergamo, the northern province of Como, and almost universally throughout Tuscany. This is a contract between the owner of the soil and the peasant, by which the first gives a habitable house, suitable for farm uses, with a certain quantity of land, not only under proper cultivation, but planted with mulberry trees and vines, the latter with their props. The peasant contributes his labor, and also the working capital in seed, farm implements, and cattle. The produce of the soil is divided into equal shares between the two parties. For the house and meadow land the rent is paid in money, and though the immediate products of the soil are shared equally between the peasant and proprietor, special stipulations often regulate the division of the grapes and the mulberry leaves, the latter the most important product of the territory. In the northern provinces of Como, and the northern part of Milan, as I am informed, there is a stipulation by which the produce of the soil is wholly given to the tenant, for which a fixed rent is paid in corn, called *fitto a frumento*, and the cocoons and other products grown in plantations, *i.e.*, mulberries, vines, etc., are shared between the proprietor and the peasant. Where the silk industry prevails the women are seldom employed in field labor, the silk mills finding them employment; and during winter, when there is no outdoor occupation, they spin the flax grown on their small farms. The houses of the peasantry in general are poor but not squalid, since the breeding of the silkworm necessitates their being built of a certain size, and tolerably well ventilated. The country people are decently clad, the men in fustian and cotton velvet, the women in cotton prints.

The mulberry tree appears to have formed an object of cultivation at a very early period in the western parts of Asia and in Europe. The attention there bestowed upon it must have been solely on account of its fruit, for the knowledge of the mode of rearing silkworms was confined to the people of Central and Southern Asia, until the sixth century. The white mulberry, *morus alba*, is considered both in Italy and France by far the best variety for cultivation as food for the silkworms. It is a tree of much more rapid growth than *M. nigra*, and its leaves are not only less rough and more succulent, but they contain more of the glutinous milky substance, resembling caoutchouc, which gives tenacity to the silk produced by the worms fed on them. When the silkworm was first introduced into the north of Europe there appears little doubt but that it was fed on the leaves of the black mulberry. The white mulberry is more tender, and putting forth its leaves much earlier than the black mulberry, it is more likely to be injured by spring frosts. It was, consequently, long confined to Greece: but when Roger, King of Sicily, in 1130 ravaged the Peloponnesus, he compelled the principal artificers in silk and breeders of silkworms to remove with them to Palermo, and determined to try the white mulberry in that country. The white mulberry was accordingly transplanted into Sicily, and flourishing in its fine climate, that island became the great mart of nearly all the raw silks required for the manu-

facturers of Europe. In 1440, the white mulberry was introduced into Upper Italy, and in the reign of Charles VII. the first white mulberry tree was planted in France.

According to Count Dandolo a hundred trees, great and small, will furnish 7,000 lbs. of leaves, and these will be sufficient for 200,000 silkworms. The greatest care should be taken, whatever may be the quality of the leaf, to prevent its being heated or fermented, whether just picked or when kept. The leaves ought not to remain long in the baskets or sacks in which they are gathered. The mulberry tree thrives in colder countries than Lombardy; the leaves are gathered in May, when the tree is in full vegetation, and when the silkworms are feeding vigorously, but it should only be stripped once a year, and that crop should be gathered, so as to allow time for the leaves to shoot again before the cold weather. Many peasants have a custom of gathering the leaves in the autumn for the feeding of cattle, which is condemned by all good horticulturists, since the mulberry tree suffers from this practice, as well as from the condition of the weather. About five-sixths of the raw silk is converted into organzine and tram, which increases its value about 30 per cent. The factories in which this work is carried on, especially the principal ones, are fitted up in the most perfect manner, and conducted on the most approved principles. A great number of the works are dispersed over different localities, adapted for the purpose, either by the cheapness of labor, proximity to waterworks or waterfalls to set in motion the machinery, for the facilities with which fuel can be obtained or abundance of cocoons in the neighborhood. The mills for making the organzine (*filatoi orsoj*) are not so numerous as those for spinning. The principal spinning mills work five or six months in the year, and those of lesser importance from four to six months only. The organzine mills are nearly always at work.

The period of activity with the silkworm occurs in the month of May. The eggs are about the size of mustard seeds, and the larvæ of the first age are one or two lines long, and of a dark color. In five days begins the second stage. In the third stage the worm is naked, whitish, and lives six days before attaining the fourth. The fifth stage is the longest, lasting nine days, and at this time the worm is very voracious. It then ceases to eat, walks about, and, in about 36 days after the worm hatches, it begins to make its cocoon, which is spun from the large-sized glands opening in the under lip. The cocoon is spun of a continuous thread about 1,000 yards long, and is finished in about four days. The cocoons vary in color; the white, two varieties of yellow, and the green. There is a considerable difference in weight, according to the races, the conditions of atmosphere in which the silkworms have been reared, their feeding, etc. The white and green Japanese cocoons are generally lighter than the white and yellow Italian races. Thus 600-1,000 white or green Japan cocoons weigh one kilog., 400-700 white or yellow Italian cocoons weigh one kilog. The cocoons intended for seed, *i.e.*, for the hatching out of the silk moth, are first selected with care, and the remainder are subjected to some one of the several processes for destroying the life of the chrysalis, as, otherwise, the moth would force its way out through the cocoon and spoil it for reeling. The cocoons, which are then called dry cocoons, are next assorted, those as nearly of a size as possible being put together, and the largest by themselves. The small cocoons are much less valuable, and the *dupions*, or double cocoons, are generally rejected, as there is difficulty in reeling them. All soft or imperfect cocoons are also rejected. When thus assorted they are ready for reeling. The floss of coarse loose silk is taken off, and the cocoons put, eight or ten at once, in a kettle or a pan of quite warm but not boiling water, and stirred with a bit of broom, or a whisk, lightly and gently till the silk fiber is loosened and can be caught up. A fiber from each cocoon is then passed through the holes of the brass plate which covers the pan or kettle, and then repeatedly crossed and carried forward to the reel. The reeling process requires great skill to keep the thread even, as the amount of silk in each cocoon varies, and it is constantly necessary to be joining new threads. The threads are also of different degrees of fineness on different portions of the same cocoon. The threads thus united in the reel form what is known as raw silk.

Raw silk, before it can be used in weaving, is made to take one of three forms, being converted into either singles, tram, or organzine. The first, which is the most simple process, consists of merely twisting the raw silk, in order to give more firmness to its texture; in fact, during its progress towards the formation of the two other preparations, raw silk must pass through the intermediate state of singles. Tram is formed by twisting together, not very closely, two or more threads of raw silk, and this description most commonly forms the weft, or shoot, of manufactured goods. The formation of organzine is a more elaborate performance, and is principally used in the warp, that is, to form the length of the goods. Through the courtesy of one of the partners of the well known firm of Signor Pietro Gavazzi, Via Cusani, Milan, I was enabled to examine the different processes, from the unwinding of the cocoon to the weighing and packing of the silk, carried on in their filature at Valmadrera, near Lecco. This establishment has long been most favorably situated in a locality possessed of many natural advantages. It contains every requisite for the storing of the cocoons, and has a numerous *clientele*, the result of the indefatigable efforts of the partners for perfecting every branch of the business. At the time of my visit the different operations were proceeding in rooms spacious and well ventilated, each containing about 20 persons, who carefully watch and guide the threads of silk as they traverse the machines, the whole of the machinery being propelled by water power. The health, comfort, and cleanliness of these employés are objects of constant solicitude to the firm, since much of the success in the fabrication of the article depends upon the intelligence and care bestowed upon it by the persons thus employed.

The Casse di Risparmio of Lombardy, one of the wealthiest and most prosperous of the institutions of the country, which has its head office in recently erected and spacious buildings in the Via Monte di Pieta, at Milan, is largely useful to the merchants engaged in the silk trade. It is a common practice for such to deposit their bales of silk and cocoons and receive advances thereon. Visiting this fine establishment, in company with Vice-Consul Kelly, we were enabled to observe minutely every variety of cocoon, their colors, sizes, shapes, etc., and the modes of packing that distinguish the products of different silk growing countries. The statistics of the Casse show that during the year 1877 the quantity of silk deposited in their hands amounted to 631,359 kilogs., valued at 27,054,000 lire, and the sum advanced was 9,897,435 lire, interest being at the rate of 5 per cent. The funds at the disposal of the Casse are very considerable; on the 31st of December, 1877, the capital of the establishment consisted of 25,600,340 lire, and the amounts lying in its hands belonging to the depositors came to 253,850,000 lire additional.

The manufacture of silk fabrics, although dwarfed in importance when compared with the production of the raw material, is carried on to a considerable extent in the different towns and districts. The principal silk goods manufactured are plain broad silks, black and colored, failles, taffetas, satins, and, in a less proportion, figured silks, velvets, scarfs, ribbons, parasol and umbrella silks, silk hose, silks for furniture, silks for churches, and ecclesiastical vestments. The principal towns in districts employed in the trade are—Como, with about 6,500 looms, almost exclusively employed in the manufacture of plain silk for dresses. Milan, with about 1,000 looms employed in the manufacture of plain silks, figured silks, silks for furniture, silks for churches, silks for ecclesiastical vestments, umbrella and parasol silks, cravats, scarfs, ribbons, and silk hose, etc., and about 100 looms employed in the manufacture of velvet. Turin, with about 500 looms for the manufacture of a variety of silk goods. Genoa (Riviera), with about 1,000 looms employed in the manufacture of velvets. Naples (S. Leucio), with about 500 looms for various silk goods. Rome, with about 100 looms for various silk goods. Catania, with about 1,000 looms for plain silk goods. Lucca, with about 800 looms for plain silk. Florence, with about 1,000 looms for plain silk goods. The total number of looms is about 20,000. With regard to the proportionate extent of steam, water power, or hand-looms employed, I have been informed by the same authority that there are about 500 steam or water power looms, and the remainder are hand-looms. These steam or, more generally, water power looms are situated at Menaggio, Cernobbio, Desio, and Chiari; the looms of Desio, belonging to the firm of E. P. Gavazzi, are employed in the manufacture of umbrella silks. The hand-loom weaving is carried on both in the town and country districts. Of the 6,500 looms in the city and province of Como, two-thirds may be said to work in the suburb and country district, while at Milan the hand-loom work is almost exclusively confined to the city. At Turin there is one hand-loom weaving establishment. At Milan there are five, the most important belonging to the well known firm of Ambrogio Osnago. At Naples (S. Leucio) there is one. The hand loom weaving is, however, chiefly carried on by the workmen in their own dwellings. At Como, of the 9,000 silk weavers, 6-10ths are men and boys, 4-10ths women and girls. The average rate of earnings for the men upon figured silk goods is from 2fr. to 3fr.50c. per day, and upon plain silk goods, from 1fr. 50. to 2fr. 50c. per day. The average rate of earnings for the women is 1fr. 25c. a day of twelve hours; the rate for girls varying from 50c. to 80c. a day. The exportation of silk tissues during the year 1877 has notably declined upon former years, while the imports have increased, showing that although Italy possesses *par excellence* the raw material, she makes purchases from abroad of the manufactured article.

The attacks of the silkworm disease have occasioned many important changes during several years past, more especially in the larger use of Chinese and other Asiatic silks, the facilities for obtaining which have been greatly extended by the opening of the Suez Canal. The effects of this scourge vary in a remarkable manner, according to the time of the attack, the intensity of the disease, and a number of other circumstances. Wherever the disease appeared recourse was had to seed from a distant place, taking as much care as possible that it should be brought from some part which had not been attacked by the disease. It results that in Italy, and in some provinces more than others, the cocoons produced of late years have been of all sorts, all shapes, and of every quality; and in spite of the best directed efforts, made with a view to obtain a satisfactory production, as well in point of quality as quantity, it must be admitted that the crop of silk since the commencement of the disease has been diminished to one-half of what it was in ordinary years. Many looms, and especially the smaller, have remained idle, and the larger have been kept on short time.

The manufacturers, especially in Upper Italy, have modified their machinery, so as to increase their business by working the Chinese and Levantine silks. Notwithstanding that silk weaving has suffered more than any other trade, the Italians have not despaired; on the contrary, they have given proof of great intelligence, zeal, and activity in endeavoring to mitigate the effects of this calamity. They have not neglected the cultivation of their mulberry trees, and they have instituted examinations by the microscope, and experiments, with a view to secure good cocoons in greater abundance than the normal production of recent years. If any convincing proof were needed of the ability of Italians to contend with the difficulties inseparable from commerce, this might be found in their treatment of the silkworm.

The statistics of the exports of raw and thrown silk show that, in spite of the diminished production within the country, a larger quantity has been exported abroad. The opening of the eastern sources of supply has naturally led to larger importations to fill up the vacuum, and this prominent feature in the trade renders it important to improve the dock and storage accommodation at the ports of Venice, Brindisi, and Genoa. It is, moreover, desirable to quicken the period of transit by the Mont Cenis railway, which by passenger trains only occupies twenty-two hours between Turin and Paris, whereas for goods traffic many days are now consumed. The importance of the early completion of the St. Gothard route cannot be overlooked, since the connection between Switzerland, Germany, Austria, and Italy is at present hindered by the difficulties of transport. The Italian filatures use a very considerable quantity of China, Japan, and Bengal silks, which are highly appreciated by the consumers.

The Asiatic silks are introduced direct from China, besides being obtained at Lyons, Marseilles, and London. By far the greater portion of the production of the Italian silk mills is purchased by the merchants of Lyons, and worked into the splendid fabrics for which that city has always been famous. The largest consumers, next to Lyons, are found among the manufacturers of Switzerland and the Rhenish Provinces. The remainder is distributed between the different European silk markets, viz., England, Austria, Saxony, Russia, the smallest quantity being woven in Italy herself.

The falling off in the demand for silk of all kinds which occurred during the year 1877 must be regarded as quite exceptional, owing to the general depression of commerce throughout Europe, for in such case silk, an *article de luxe*, would be among the first to feel its effects. It may, however, be reasonably anticipated that, with the return of peace and prosperity, this great industry of Northern Italy, upon which so much ability and attention have been concentrated, may again expand into larger dimensions than it has ever yet assumed.—*Journal of the Society of Arts.*

HOW TO MAKE PHOTO PRINTING PLATES.

By T. BOLAS, F.C.S.

THE SWELLED GELATINE METHOD.—This method of making phototypic blocks is founded on the circumstance that gelatine which has been rendered sensitive to light by means of a soluble bichromate becomes so changed by exposure to light as to lose its property of swelling when immersed in cold water. If, for example, a plate of metal or glass is covered with an even layer of bichromated gelatine, and this film is exposed to light under a negative, it will be found that on soaking the plate in cold water the swelling of the unaltered parts of the gelatine will give rise to a delicately modeled reverse of a typographic block. If the surface of this be rendered conductive of electricity by means of bronze powder or black lead, and copper be deposited on it by means of the electrotypic method, the resulting electrotype forms a printing block adapted for use in the ordinary typographic press. As a matter of actual practice it is, in the majority of cases, more convenient to take a plaster cast from the gelatine, and reproduce this in metal, than to electrotype direct on the gelatine relief.

The swelled-gelatine method will be found to require less special knowledge and experience than most other methods of producing phototypic blocks; but in many cases the results are not equal to those obtained by etching on metal plates. At the same time it should be borne in mind that certain subjects, such as engravings, in which the lines are closely packed together and rather deficient in intensity, sometimes yield better results by the swelled gelatine process than by etching methods.

By the use of an isolated sheet of sensitive gelatine, instead of a layer fixed on a rigid plate of metal or glass, many advantages are secured, and the manipulations are rendered more certain.

The first stage in the process consists in the preparation of uniform films of plain insensitive gelatine, and these films are prepared by drying a layer of gelatinous solution on a horizontally-placed glass plate. It is a matter of considerable interest to examine the physical properties of commercial sorts of gelatine, and more especially to note their behavior when their solutions are dried on leveled glass plates. Some kinds of gelatine, represented by Coignet's "gold label" and "silver label" gelatines, tend to yield films which are either covered with ring-shaped depressions or are marked with cursive lines, forming patterns of great complexity. Gelatines of this quality are unsuited for our present purpose, although invaluable to the photo-mechanical printer in other cases. Gelatines of another kind, represented by Nelson's "transparent sheet" gelatine, tend to form films which are remarkably even and free from surface markings, this tendency towards the production of even films being increased by churning the gelatinous solution.

The solution for the preparation of the films is prepared by dissolving one part of the gelatine in three or three and a half parts of water, any excess of heat beyond that required to effect the solution being avoided. The solution is next churned for about ten minutes by means of an American churn or egg beater; after which it is filtered through muslin and is then allowed to remain at rest sufficiently long to clear itself of air bubbles. It is now ready for being poured on the level glass plates upon which the films are to be dried. Plate glass should be employed, and the surface intended for the reception of the gelatine ought to be waxed. This waxing is best performed by heating the glass to a temperature somewhat above the melting-point of wax, and rubbing it with a lump of wax; the excess of this substance being then polished off by means of a soft rag, care being taken to perform this polishing off while the glass is still warm. The waxed plate may either be supported by means of three ordinary leveling screws, or the following arrangement, which is calculated to save much time, may be employed instead: A portion of the operating table is covered by a flat metal casing or box which is about an inch and a half deep, and is kept hot by means of a current of steam. On this hot plate three or four thicknesses of brown paper are placed, and over these a sheet of plate glass, which is about the same size as the top of the hot plate. This plate of glass is once for all set level by packing up the legs of the table, or by other suitable means, and it thus forms a level and warm surface which is always ready to hand. If the plates, flooded with gelatine solution, were placed immediately on this warm sheet of plate glass, any trace of the gelatine which might flow over the edges would cement them down so firmly as to render their removal a matter of some difficulty. It therefore becomes a point of convenience to rest each plate on three little blocks of metal placed on the glass base-plate. Metallic blocks, of uniform height, can be readily obtained in the form of the quadrats or "quads" used by printers, care being taken to place similar surfaces upwards in the case of each set of three "quads." By this method plates of any required size can be rapidly placed in position over the warm and level base-plate of glass; and, when glass plates having their faces approximately parallel are employed, this method of leveling is quite sufficiently accurate for all ordinary purposes.

All being now ready, one of the waxed plates is gently warmed, and is then supported over the warm glass slab by means of a set of three "quads" placed in position, and the warm, clear, gelatine solution is poured over its surface so as to form a layer rather less than an eighth of an inch thick. Other waxed plates are similarly coated with gelatine, and supported over the warm base-plate until the space at command is used up, when the gelatinous layers may be left to dry. It is rarely necessary to fix strips of wood round the edges of the waxed plates, as the viscosity of the gelatine solution is sufficient to prevent it running over the edges of the glass, excepting in the case of certain kinds of gelatine, or when a considerable proportion of spirit has been added to the solution. An addition of spirit is sometimes useful in case surface-markings tend to make an appearance. When the films are dry they may be easily removed from the glass plates by cutting through the edges with a sharp knife; but, as perfectly dry gelatine is extremely brittle, it is generally well to place the plates bearing the dried films in a damp locality for a few hours before proceeding to remove the sheet of gelatine. If this precaution be not taken it will occasionally happen that a gelatine film will fly into hundreds of fragments as soon as an attempt is made to remove it from the glass; but the trace of moisture which is absorbed during a short sojourn in a damp place effectually prevents this. The stock of gelatine films should be protected from damp by being kept in a tin box.

The sheet gelatine prepared as above directed should be sensitized by being soaked in a three and a half per cent. solution of potassium bichromate until it becomes quite

flaccid, after which it must be squeegeed down to a piece of glass, the edges of the gelatine being secured by strips of wood and American clips. It is then allowed to dry in a warm room well guarded against the entry of actinic light. After having been dried and separated from the glass the gelatinous pellicle is ready for exposure under the negative. Although a dense negative is desirable, it is by no means absolutely essential that it should be over-dense, as satisfactory results can often be obtained from a decidedly thin negative. The duration of exposure required will vary according to many circumstances—such as the quality of the gelatine, the rapidity with which the sensitive pellicle has been dried, and other circumstances. It may, however, be generally stated that the exposure should be continued until the image appears in dark brown on the clear lemon-yellow ground of the bichromated gelatine, and this effect will generally be produced by an exposure of ten or twenty minutes in sunshine, or a proportionately longer period in a duller light. When the air is damp, and a prolonged exposure is anticipated, it is as well to put a piece of oiled silk or other water-proof material between the gelatine pellicle and the padding of the printing frame, as, if the gelatine were to absorb any moisture during the operation of printing, mischief might arise in several ways. In the first place, the presence of moisture would tend to make the gelatine insoluble all over, thus lessening its power of swelling in cold water; while damp might also cause the gelatine to stick to the negative so tightly as to lead to the removal of portions of the film, and at the same time the expansion of the gelatine would lead to a want of sharpness on the part of the gelatinous print.

The exposure having been made, the gelatine pellicle is placed in cold water, and is allowed to soak until sufficient relief is obtained. Several hours are generally required for this, and when the pellicle is once in the water it may be exposed to light without fear of injury. The softened gelatine relief is next placed, face upwards, on a sheet of glass, and after having been covered with a piece of wet paper to protect its surface from injury, the squeegee is applied until adhesion is established between the gelatine and the glass. This being the case, the paper is removed and the face of the gelatine relief is rendered surface-dry by dabbing with a soft cloth, care being taken to remove all drops of water from the deeper parts of the gelatine mould. The next step is to freely oil the gelatine film, taking care to work the oil well into the hollows by means of a rather large camel's-hair brush cut off short; after which the excess of oil must be carefully removed, just as in the case of the surface water. Four pieces of wood or metal are now rested on the edges of the gelatine relief, so as to form a border fitted to retain the plaster, which is now to be poured over the oiled relief.

Much depends on the quality of the plaster of Paris employed, and it is important that it should either be freshly burned, or that it should have been kept in an air-tight vessel. The best kind is known as "superfine," and costs about five times as much as the common quality sold in the oil shops. There is a plaster works at Mount Pleasant, Gray's Inn lane, where the right kind can be obtained. When the casting is to be performed the following appliances must be provided: 1. Jar containing plaster of Paris. 2. Basin for mixing. 3. Large spoon for stirring the plaster and water together. 4. Smaller spoon for taking plaster from the jar. 5. A camel's hair mop about an inch in diameter, to be used for chasing away air bubbles. 6. A jug of water. As much water is put into the basin as is judged to be sufficient for mixing the required quantity of plaster, and, the basin of water being placed on the table, the jar of plaster is held a little distance over it, a steady stream of the powder being now worked out by means of the spoon, care being taken that it falls so loosely as to be immediately wetted on falling into the water. The heap of plaster falling into the water should be so proportioned that when its apex just appears above the surface of the liquid, the quantities shall be right for mixing into a thickish cream. The requisite amount of plaster having been added to the water, the contents of the basin are rapidly mixed by means of the larger spoon, and the liquid plaster is then poured over the gelatine relief to a depth of about half an inch. The camel's-hair mop is now introduced into the liquid plaster, and is worked over the whole surface of the relief with an up-and-down movement, care being taken that in moving the mop up and down it is not entirely removed from the liquid plaster at each stroke. The air-bubbles having been thus chased away from the surface of the relief, some coarser plaster is mixed and poured over the fine coat, so as to make their joint thickness about an inch and a half, more or less, according to the size of the cast.

In about ten minutes the plaster will be sufficiently set for removal from the glass, this being done by exerting a gentle and steady pressure on one side of the cast, when the plaster block and the wet gelatine relief will be found to slide slowly off the glass plate. One corner of the gelatine being now lifted, the pellicle can be easily removed from the plaster without injury to either. Fresh plaster casts may then be made from the gelatine relief; and after our plaster cast has been put aside for a few hours to harden it is ready for the next operation.

THE PARIS EXHIBITION.—FLORA AND ZEPHYR.—BY BOUGUEREAU.

ENGLISH OAK STAIN FOR BOTTOMS OF BOOTS AND SHOES.—The process used by the best English shoe manufacturers to stain our hemlock and union sole, so that it shall resemble English oak, is simply as follows: Take equal quantities, say one ounce, of borax and oxalic acid, and put in a quart of water. Be sure the acid does not predominate, and in some cases a very little more of the borax will be better. Then when the shoe goes to the finishers, after sandpapering the bottom, when dry, dampen down or wet the grain with this solution, and, when nearly dry, apply French chalk or pipe clay in the usual way. This brings out a white bottom, finely tinted with a shade of pink. If more yellow, and not so much red, is wanted, put in a little turmeric root or chrome yellow. Care must be taken that the sole is not afterward wet while in stock, or the hemlock color will come out again.